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TRI-LEVEL STUDY OF THE CAUSES OF TRAFFIC ACCIDENTS

Volume I. Causal Factor Tabulations and Trends*

Executive Summary

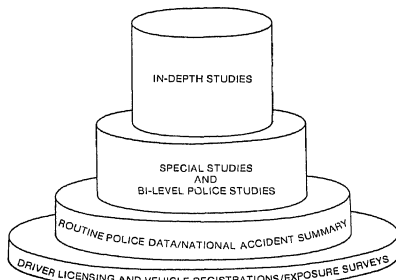
The National Highway Traffic Safety Administration (NHTSA) has sponsored a variety of accident investigation studies since 1968. These studies, to collect, collate, and analyze real-world accident data, provide a foundation for the development of safety strategies, rule-making plans, assignment of priorities, and measures of the effectiveness of countermeasure programs at the national level. In summary, specific objectives of the national accident investigation are to:

- Identify the causes and mechanisms of motor vehicle accidents and subsequent injuries, so that effective measures, devices, and traffic safety programs can be initiated.
- Provide accident information and analyses on priority safety problems for research and rule making.
- Assess the worth of motor vehicle and highway safety standards now in force, and predict the potential effectiveness of new standards under consideration.
- Pinpoint defects in motor vehicles or highway design as the basis for scientific investigation.
- Validate advanced accident investigation techniques in the field to improve the precision, accuracy, and efficiency of the collection of accident data while reducing the collection burden of on-scene investigators.

Recent trends in accident research have led to a multi-level approach to national accident data collection, processing and analysis (see Figure 1-1). The level of sophistication ranges from population data and the basic, minimal amount of data contained in routine police reports of all accidents, to the most

comprehensive, in-depth data contained in special reports by professional accident investigation teams. In the basic level of collection, a small number of data elements are collected on the population at large and on a large number of accidents. Data from vehicle registrations and drivers' licenses are utilized as supplemental information at this basic level. At the top level, hundreds of data elements are collected on a small number of select accidents which are designated for study. Intermediate levels involve various additional data elements not routinely collected at the basic level in order to study some specific aspect on a sub-sample of accidents.

Figure 1-1—Multi-Level Concept



ACCIDENT DATA COLLECTION AND ANALYSIS

A composite approach, designated as a tri-level study, and devised from this multi-level national concept, is used in this project. It is distinguished from other accident investigation studies being made by

* The full report for the period August 15, 1973–August 15, 1974, prepared by the Institute for Research in Public Safety (IRPS) of the Indiana University School of Public and Environmental Affairs, under contract DOT-HS-034 3 535.

centration on the pre-crash (accident causation) phase of motor vehicle accidents. Such tri-level studies involve simultaneous accident data collection and investigation from three levels of detail, within a single study. These levels, in order of increasing detail and decreasing case volume per unit cost, are:

- The collection of baseline data on the study county from police reports, vehicle registration files, driver license files, roadway inventories, and local surveys (Level A).
- The on-site investigation of accidents immediately following their occurrence by teams of technicians (Level B).
- The independent, in-depth investigation of the subset of the accidents investigated on-site, by a multidisciplinary team (Level C).

Data collected on Level A enable the representativeness of study samples to be assessed, and also provide a basis for comparison of accident and general populations. The Level B (on-site) investigations enable moderately detailed information to be collected from a relatively large number of accidents. Since the expansion of coverage in February, 1974 to 24 hours per day, IRPS has acquired accidents on Level B at the rate of approximately 70 to 80 accidents per month (840 to 960 per year). On Level C, a multidisciplinary team has conducted highly detailed investigations at a rate which has recently averaged 100 accidents per year.

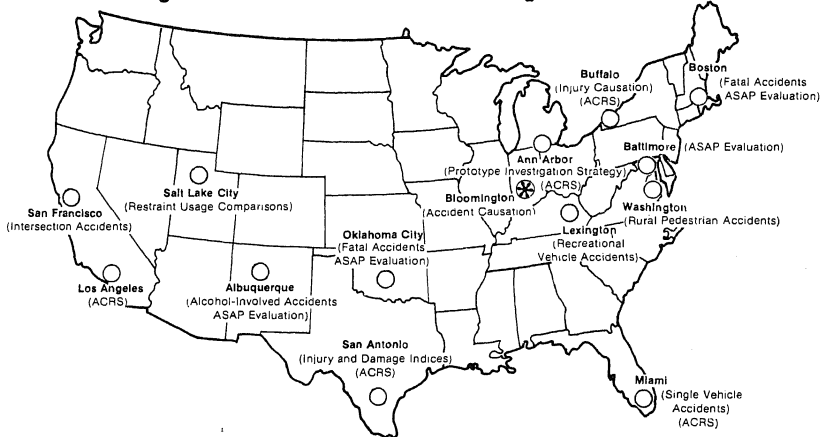
Figure 1-2 shows the location of many of the teams currently funded by NHTSA. Each of these is a "special study," focusing on a particular aspect of the highway traffic safety problem. At its core, each also includes a multidisciplinary accident investigation team composed of medical doctors, engineers, psychologists, and other accident reconstruction specialists who scientifically analyze accidents to determine accident and injury causation and to make recommendations for possible solutions. Increasingly, these studies are developing levels of data which provide for both clinical evaluations of accident and injury causation, as well as statistically significant information on specific priority problems.

Of the teams shown in Figure 1-2, those in Buffalo, Ann Arbor, and Bloomington, are tri-level in character. The present study, which is focused on accident causation and crash avoidance, was conducted

by the Institute for Research in Public Safety (IRPS) of the Indiana University School for Public and Environmental Affairs, Bloomington. The study at Buffalo, conducted by Calspan, Inc., concentrates on the crash phase and the examination of injury causation. The Calspan team is also participating in an assessment of the effectiveness of vehicles equipped with air-cushion restraint systems. The study of Ann Arbor, conducted by the Highway Safety Research Institute (HSRI) of the University of Michigan, has as its objective the development and testing of a prototype national accident sampling strategy. The HSRI team is also participating in the air-cushion restraint system evaluation.

The general objective of this special study is to satisfy NHTSA's on-going needs for data regarding accident causation and crash avoidance. Specific objectives of the program are to:

- Identify those factors which are present and serve to initiate or influence the sequence of events resulting in a motor vehicle accident.
- Determine the relative frequency of these factors and their causal contribution within a defined accident and driving population.
- Assess the potential benefit of radar and anti-lock braking systems in reducing the incidence and severity of automobile accidents.
- Assess the error/accident relationship as a function of driver age, driving knowledge, vision, driving experience, and vehicle familiarity.
- Apply the taxonomy or group identification concept to the identification and definition of problem driver types, and from this to formulate recommendations for dealing with particular classes of drivers.
- Apply the taxonomy concept in particular to the alcohol-impaired driver, in order to identify the types of driving-performance mistakes made by particular types of alcohol-impaired drivers under particular types of conditions.
- Develop new methodologies for assessing the role of human factors in accident causation, including such factors as risk-taking propensity and decision-making ability.



ACRS—Air Cushion Restraint System Evaluation Regional Team

Tri-level methodology has been employed featuring baseline data collection on Level A, on-site investigations of moderate detail on Level B, and in-depth investigations of intensive detail on Level C. During the past year, IRPS has been successful in having special summary tables produced providing more definitive study area data regarding licensed drivers and registered vehicles, has conducted general population surveys of driver vision and driving knowledge, and has extended coverage in the on-site level with the result of more than doubling the case acquisition rate and also improving the representativeness of accidents considered.

The period reported covered the conclusion of Phase IV data collection and the start of Phase V*. During Phase IV (June 1973–May 1974), IRPS conducted 528 on-site (Level B) and 103 in-depth (Level C) investigations. During the one-year period running from mid-August 1973 to mid-August 1974, which is the period of performance covered by this report, 642 on-site and 104 in-depth investigations were conducted. A summary of data acquired is provided by the following tables:

Table 1-1 Level A: Baseline Data Acquired During Phase IV

Information	Date Acquired	Sampled Units	No. of Variables	Sampling Technique
Police Accident Report Data	4/74	3,314**	56	Entire reported population; special tape
Age & Sex of Monroe County Licensed Drivers	3/74	980	10	Systematic Sample from list
Monroe County Licensed Driver Vision	4/8/74 to 7/8/74	149	70	Quota; stratified by age and sex
Licensed Driver Vision-Test/Retest	4/8/74 to 7/8/74	51	112	Quota; stratified by age and sex
Monroe County Vehicle Registration Data	6/74	33,921	35	Entire passenger car population; special tape
Monroe County Licensed Driver Data	8/74	63,000	16	Entire population; special tape

* For data collection phases and dates, see Table 1-2.

** 1973 data.

Table 1-2 Summary of Accidents Investigated by IRPS Using Tri-Level Methodology

Data Collection Phases & Dates	Police Reports (Level A)	On-Site (Level B)	In-Depth (Level C)
I—10/70-5/71	3458 in 1970	469	68
II—6/71-5/72	3914 in 1971	530	151
III—6/72-5/73	3272 in 1972	306	64
IV—6/73-5/74	3314 in 1973	528	103
Combined Phases* II, III, IV	10,500	1364	318

* Phases II, III, and IV were assessed using the same causal assessment scheme, and are presented both separately and cumulatively. Phase I differed somewhat and, for the most part, is not reported herein.

In the following paragraphs the principal results and conclusions from each of the substantive report sections of Volume I, Causal Factor Tabulations and Trends, are summarized. For simplicity, causal factors will be discussed with reference to the in-depth

team (Level C) results, and will be stated as a range of the definite to probable results, based on combined Phase II, III, and IV data. The factors are ranked according to the probable level results.

Causal Factor Tabulations

- In the most recent data collection phase (Phase IV), as in previous collection phases, human factors were the most frequent causes of accidents, followed by environmental and vehicular factors, respectively (Figure 2). Human factors were identified by the in-depth team as causes of between 77.0 and 95.3% of the combined Phase II, III, and IV accidents (definite and probable result figures). Environmental factors were causes of between 13.8 and 34.9% of accidents while vehicular factors were identified as causes in 4.1 to 12.6% of the accidents investigated.
- The four leading human factor categories in accidents were: (1) improper lookout (19.2—

Figure 2

Percentage of Combined Phase II, III, & IV Accidents Caused by Human, Vehicular, and Environmental Factors

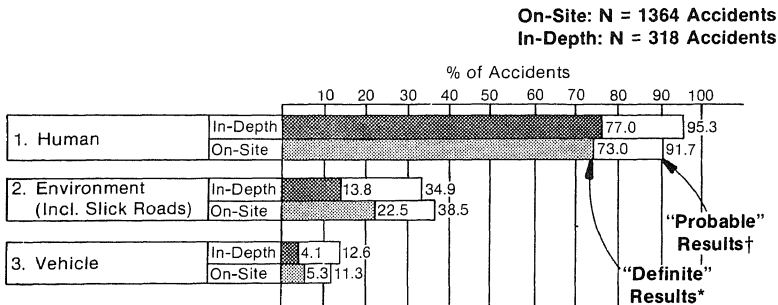


Figure 3

Percentage of Combined Phase II, III, & IV Accidents Caused by Specific Human Direct Causes

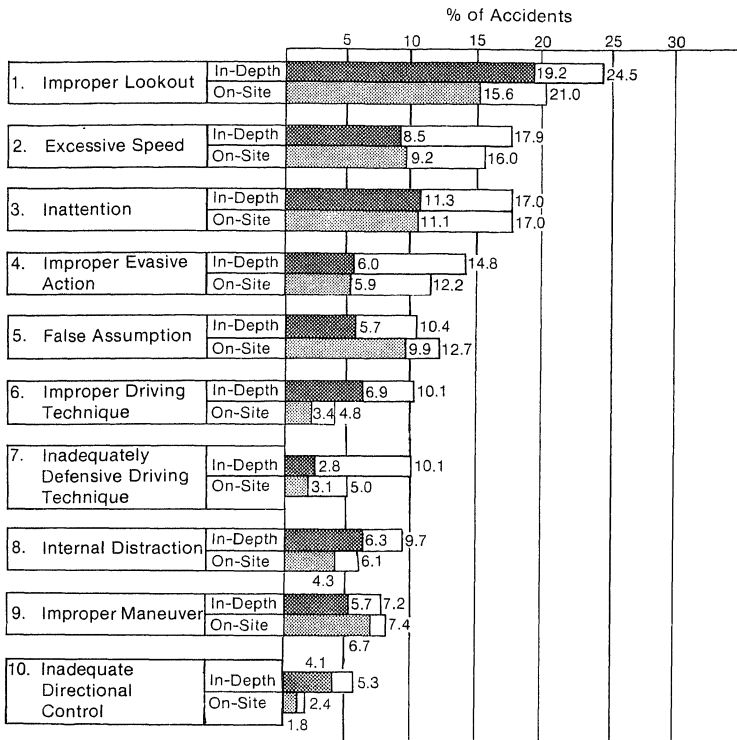
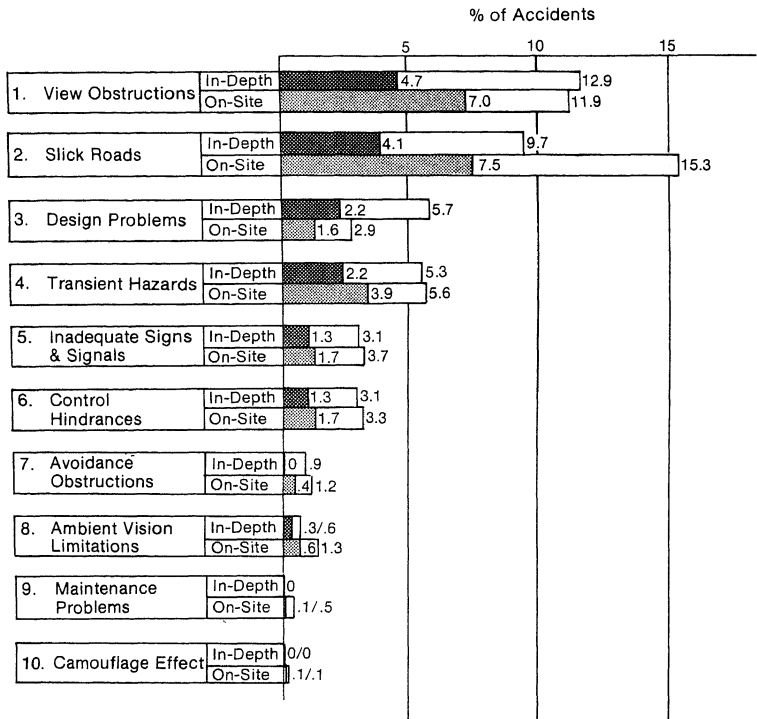
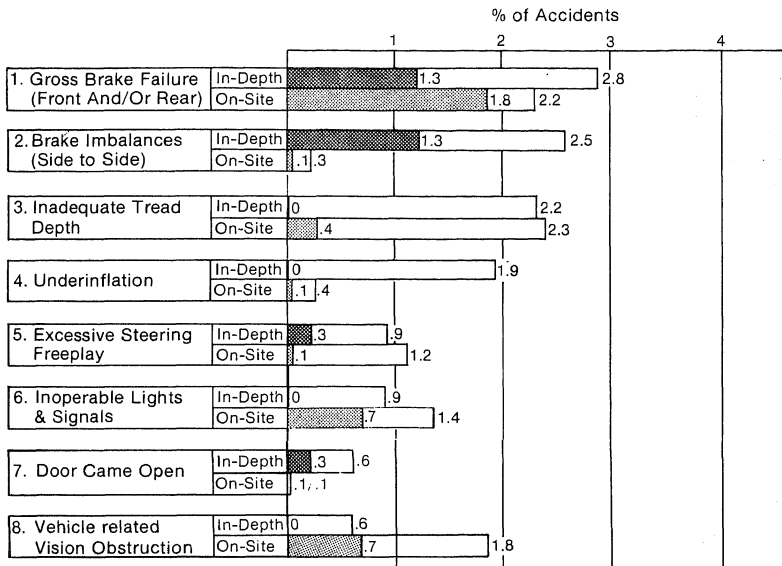


Figure 4

Percentage of Combined Phase II, III, & IV Accidents Caused by Specific Environmental Causal Factors



Percentage of Combined Phase II, III, & IV Accidents Caused by Specific Vehicular Deficiencies



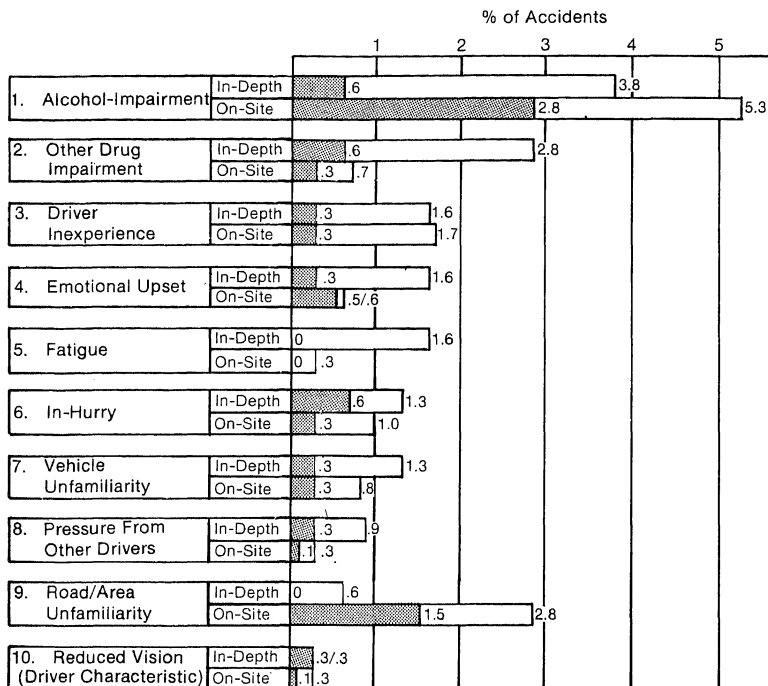
24.5%), (2) excessive speed (8.5—17.9%), (3) inattention (11.3—17.0%), and (4) improper evasive action (6.0—14.8%). (Figure 3)

- The leading environmental factors were: (1) view obstructions (4.7—12.9%), (2) slick roads (4.1—9.7%), and (3) roadway design problems (2.2—5.7%). (Figure 4)
- The most frequent vehicular causal factors were: (1) gross brake failure (1.3—2.8%), (2) side-

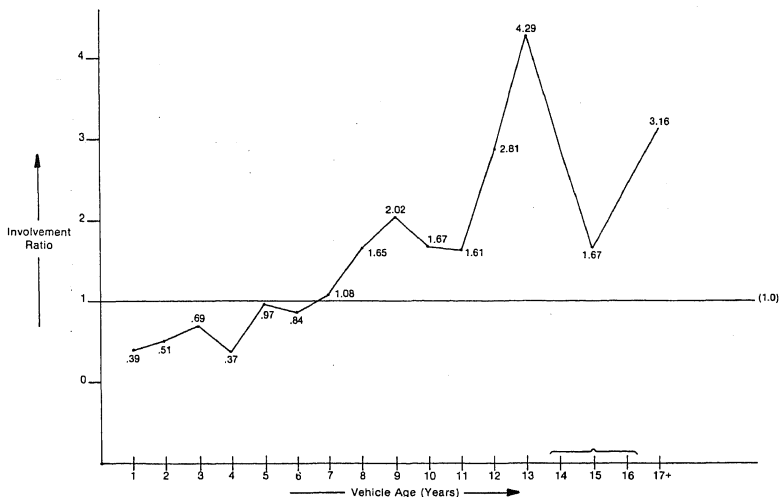
to-side brake imbalances (1.3—2.5%), (3) inadequate tread depth (0—2.2%), and (4) under-inflation (0—1.9%). (Figure 5)

- The most frequently implicated human condition or state was alcohol-impairment, a cause in 0.6—3.8% of the Phase II, III, and IV accidents. However, these figures increased subsequent to the expansion to 24 hour per day coverage mid-way through Phase IV (Phase IV in-depth results

Percentage of Combined Phase II, III, & IV Accidents Caused by the Major Human Condition or State Subgroups



Involvement Ratio Plot of Vehicles Involved Due to Mechanical Problems—Compared to all Vehicles in Accidents



0—7.3%, on site results 2.3—7.2%).* (Figure 6)

- Vehicles seven years of age and older were over-represented among those vehicles involved in accidents as a result of their own vehicular degradations and failures. However, it does not appear that older vehicles were overrepresented in accidents *per se*, possibly due to being driven less each year. (Figure 7)

Trend Analysis Across Phases

- Of the ten most frequently identified causal factors, statistically significant trends were identified for five (on-site data). These were inattention

(downward trend), improper evasive action (downward), false assumption (downward), improper driving technique (downward), and driving technique inadequately defensive (upward). Of these, only for improper evasive action was the in-depth trend also statistically significant and, as for on-site, the character of the trend was downward.

- Of the causal factor summary groups, statistically significant downward trends existed in the on-site data for human conditions and states and environmental factors (both including and excluding slick roads). According to in-depth data, neither of these varied significantly; however, a significant trend of mixed character was noted in the in-depth data for vehicular factors. Results for vehicular factors dropped sharply between

* Based on the investigation of accidents representative of all reported accidents as to severity (approximately 70% property damage, 29% personal injury, and less than 1% fatal).

Phases II and III, but then rebounded to an intermediate figure in Phase IV.

On-Site vs. In-Depth Results Comparisons

- Percentage results obtained are generally quite similar. For example, of the top-level categories, the probable level, Phase II/III/IV results for in-depth and on-site are: human factors, 95.3 and 91.7%; environmental factors/including slick roads, 34.9 and 38.5%; and vehicular factors, 12.6 and 11.3%.
- Of the ten most frequently cited causal factors, large result differences in combined Phase II/III/IV data occur for only two factors, with Level C results exceeding those for Level B in both cases; these factors are improper driving technique (probable results of 10.1 and 4.8%) and inadequately defensive driving technique (probable results of 10.1 and 5.0%, respectively).
- However, based on a casewise review of accidents investigated by both on-site and in-depth teams, it appears that the teams often differ as to the specific causal factors cited. The specific causal factor most consistently applied was ambient vision limitations; the on-site and in-depth teams agreed in naming this factor 11.7 times as often as they disagreed. Among the least consistently applied of the frequently cited factors was improper driving technique; the teams disagreed in the implication of the factor 2.7 times as often as they agreed in naming it. Among human factors in particular, labeling difficulties (in choosing from among similar categories) are indicated.
- Based on the agreement/disagreement analysis, the most important problems in assessing the top-ranking causal factors are that on-site teams often fail to identify or cite improper evasive action, improper driving technique, and inadequately defensive driving technique, in situations where in-depth results indicate they should.

Representative Assessments

- The Monroe County study area was found to be generally representative of the nation, differing principally with respect to driver age (younger drivers overrepresented), and road and street system mileage (proportion of municipal mileage

sensitive to nonrepresentativeness with respect to either of these variables.

- Compared to all police and driver-reported accidents occurring in the county, the IRPS on-site sample was found to be representative as to such factors as driver age and sex, accident severity, and urban or rural place of occurrence. For several other measures, the samples were found to vary significantly. However, when the on-site sample was adjusted to reflect national distributions for these variables, the effect on aggregate causal involvement rates was found to be small. For example, adjustment as to accident type resulted in the human factors' result frequency being adjusted from 91.7 to 91.6%, environmental factors from 38.5 to 38.2%, and vehicular factors from 11.3 to 12.6% (probable involvement, on-site).
- Possibly due to a smaller sample size, fewer statistically significant differences were observed in comparing the in-depth sample to all county accidents. Based on the on-site experience, these were concluded to have minimal effects on overall causal involvement rates anyway.
- An exception to the insensitivity of causal results to these adjustments pertains to alcohol impairment, which increased markedly subsequent to initiation of 24 hour per day coverage two-thirds of the way through Phase IV (on-site probable level results during Phase IV increased from 2.6% prior to expansion, to 7.2% subsequent to expansion).

Recommendations are that:

- Countermeasure efforts should generally be allocated according to the relative frequency with which different kinds of factors caused accidents. For example, major emphasis should be placed on human factors, and within the human factors area, on reducing the incidence and consequences of improper lookout, excessive speed, inattention, and improper evasive action. However, the cost and effectiveness of countermeasure approaches should also be considered and may result in some adjustments as to the allocation of countermeasure effort. For example, difficulties of changing human behavior as compared to im-

- Greater effort must be made to communicate knowledge as to the causes of accidents to those driving. In particular, efforts should be accelerated to integrate results of this study into the State driver manuals and driver license tests, both on-road and written.
- With respect to environmental factors, emphasis should be placed on developing countermeasures for view obstruction and slick roads. With respect to the former, it appears that the situation meriting greatest attention is the non-signalized urban intersection, with sight distances limited by parked motor vehicles. In the study area, merely prohibiting parking for a safe distance from intersections has proven difficult to enforce, and often ineffective when enforced because of other view obstruction, and installation of three- and four-way stop signs has often been resorted to as a solution. It is suggested that new approaches, such as installing mirror systems and nondiscretionary parking prohibitors, should be explored.
- As in Phases II and III, Phase IV results continue to indicate brake failure and side-to-side braking imbalance as among the leading vehicular accident causes. This result emphasizes the importance of having periodic motor vehicle inspection procedures which can adequately detect factors which could lead to brake failure or produce side-to-side imbalances. Failures encountered have frequently resulted from problems with the brake mechanism at the wheel, such as drums being turned beyond maximum limits or self-adjustor mechanisms being improperly assembled, while side-to-side imbalances have typically resulted from friction material contamination. Thus, both a visual inspection of the brake mechanism and either on-road or dynamic brake testing appear essential if a periodic inspection program is to realize its accident prevention potential. Results also indicate that added attention to older vehicles is appropriate in an inspection program, since vehicles seven years of age and older were overrepresented in accidents resulting from vehicular problems.
- Consideration had been given to stratifying the accident sample so as to improve representativeness, even though this would be made difficult by the failure of many motorists to cooperate and the need to acquire as many accidents as possible. However, results demonstrating the minimal in-

fluence of deviations from representativeness in the samples investigated indicate that it is probably not necessary to expend significant effort, or to reject accidents and thereby reduce the total number of those acquired, in order to achieve this goal. In summary, it appears that the accidents investigated are adequately representative of the national accident picture to provide a valid indication of the relative involvement of human, vehicular, and environmental factors. This is not to say, however, that improved national sampling strategies are unnecessary, for they would undoubtedly permit a much more accurate assessment of many of the detailed questions of concern, and would further permit a tailoring of guidelines or requirements to particular types of locations.

- For the present, it is recommended that multiple levels of accident data collection be retained (e.g., baseline, on-site and in-depth collection). Baseline data collection has been important in defining the study area, assessing the representativeness of study samples, and permitting accident and control sample comparisons.

The on-site level, aside from providing the accidents and preserving evidence for in-depth investigation, has been found extremely useful where larger sample sizes are important. Recently, these have included tabulations of errors made by various classes of drivers, comparisons between most-at-fault and other drivers as to such factors as driver experience and vehicle familiarity, and both cluster and AID* analyses relating causal factors with driver characteristics.

The in-depth level has permitted the acquisition of highly detailed accident data which could not have been acquired on-scene, given limitations of time, adverse conditions, equipment portability, and expertise. For example, in-depth collection has recently involved driver knowledge, profile score, and dynamic vision testing, and the in-depth inspection of vehicles at an indoor facility.

However, this is not to say that the three levels, as presently defined, should continue unchanged; as future data needs and objectives change, collection strategies will obviously need to be adjusted accordingly, possibly requiring different types of collection or a significant redefinition of the levels which currently exist.

* Automatic Interaction Detector (AID), a statistical pro-

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Editor's Note:

The reader should keep in mind that this study took place in Monroe County, Indiana—a rather non-urban county in the Midwest. This one county cannot be considered representative of the United States in either a descriptive or statistical sense. Fortunately, many of the variables which may affect the accident picture compared very favorably with what national statistics were available (e.g., vehicle age distribution; weather conditions, etc.). However, the county was significantly different from the nation in two key areas: (1) Monroe County had an overrepresentation of drivers aged 20-24, and (2) the county had an underrepresentation of freeway/expressway/limited access type roads. Consequently, accidents which could be associated with those two variables could be over or underrepresented in this sample.

In order to obtain nationally representative data, sampling techniques must be used to select several areas of the country for study, and then accidents within those areas must be randomly sampled for investigation. Indiana University used a convenience sample—that is, they selected accidents they were notified of, could get to the scene of, and could complete an investigation on. Convenience sampling could also affect the results and, therefore, the representativeness of the data.

Given the above precautions, this data sample is still the best body of accident causal data available at this time and has produced very useful results.

For further information on the representativeness of the Indiana sample, see Section 6.0 of the full report.

ABSTRACT CITATIONS

AUTOMOBILE INSURANCE LOSSES COLLISION COVERAGES. RELATIONSHIPS BETWEEN LOSSES AND VEHICLE BODY STYLE. 1974 AND 1975 MODELS

Differences in the collision coverage loss experience of corresponding two-door, four-door, and station wagon body styles within specific car lines for 1974 and 1975 model year vehicles were investigated. Data on policy and claim related collision coverage for 1974 model year cars in the period September 1973 to August 1975 and for 1975 model year vehicles in the period September 1974 to August 1975 were supplied by the following insurance companies: Allstate, Kemper, Liberty Mutual, Nationwide, Prudential, State Farm, and Travelers. The most striking finding of this study was the consistently higher loss experience of two-door models over corresponding four-door models within the same car line, regardless of wheel-base differences. In almost every case, the claim frequency per 100 insured vehicle years, the average loss payment per claim, and the average loss payment per insured vehicle year for the two-door models exceeded the loss experience for the corresponding four-door models. Data are presented on the total exposure in insured vehicle years, the claim frequency per 100 insured vehicle years, the average loss payment per claim, and the average loss payment per insured vehicle year for 39 car lines for the 1974 model year and for 21 car lines for the 1975 model year. Investigation of the effects of the age of the driver and the deductible differences among the body styles indicated that neither of these factors can account for the differences in the loss experience for the two-door and four-door models.

Highway Loss Data Inst., Watergate Six Hundred,
Washington, D.C. 20037
Rept. No. HLDI-A-5 ; 1975 ; 44p
Availability: Corporate author

AUTOMOBILE INSURANCE LOSSES COLLISION COVERAGES. RELATIONSHIPS BETWEEN LOSSES AND VEHICLE DENSITY. 1974 AND 1975 MODELS

The relationship between collision claim frequencies and sizes of claims for 1974 and 1975 model vehicles and vehicle density were investigated. Data on policy and claim related collision coverage for 1974 model year cars during the period September 1973 to August 1975 and for 1975 model year vehicles for the period September 1974 to August 1975 were supplied by the following insurance companies: Allstate; Kemper, Liberty, Nationwide, Prudential, State Farm, and Travelers. Vehicle density is defined as the number of registered passenger vehicles per square mile in the reported garaging locations of the vehicles damaged. 1974 registration information is used in this report. The data demonstrate a relatively consistent increase in the claim frequency as the vehicle density increases for both the 1974 and the 1975 models. The 1975 model year claim frequencies are slightly higher than the corresponding frequencies for the 1974 models. Although there is a generally smooth, gradual increase in the claim frequency with increasing density, there is a very dramatic increase when the highest vehicle density group is reached. This group consists of densities greater than 1,808 vehicles per square mile.

Data on the standardized average loss payment show that there is a relatively consistent decrease in the average loss payment size as the vehicle density increases for both the 1974 and 1975 models. In every vehicle density group, the 1975 models had a substantially higher average loss payment than the 1974 models. It is concluded that there is a fundamental relationship between collision coverage losses and registered vehicle density. Vehicles listed as garaged in areas with a high vehicle density produce more frequent claims, but with lower average amounts, than vehicles recorded as garaged in areas with a low vehicle density. Both of these relationships are almost linear with the logarithm of vehicle density, with the exception of claim frequencies for the highest density areas. In addition, the relationships between collision coverage losses and registered vehicle density were substantially independent of vehicle market class, although consistent differences exist between market classes in each density group.

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Rept. No. HLDI-A-4 ; 1975 ; 30p 2refs
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AUTOMOBILE INSURANCE LOSSES COLLISION COVERAGES. VARIATIONS BY MAKE AND SERIES. 1974 MODELS DURING THEIR FIRST TWO YEARS

Variations in both the frequencies and sizes of claims for damage to 1974 model year private passenger vehicles of 12 domestic makes and six foreign makes during the period September 1973 through August 1975 are examined. Data on insurance covering damage to the insured vehicle itself were supplied by Allstate, Kemper, Liberty, Nationwide, Prudential, State Farm and Travelers. Data are presented for the following car makes: Ford, Dodge, Plymouth, Chevrolet, Pontiac, Buick, Oldsmobile, Mercury, American, Chrysler, Lincoln, Cadillac, Toyota, Volkswagen, Datsun, Mazda, Capri, and Opel. These data are segregated by market class and body style. The data show that claim frequencies varied from a low of 6.4 (Oldsmobile Omega, four-door) to a high of 18.4 (American Javelin) claims per 100 insured vehicle year. Average loss payments per claim ranged from a low of 355 dollars (Chevrolet Bel Air) to a high of 1,149 dollars (Chevrolet Corvette) and the resultant average loss payments per insured vehicle year had a low of 33 dollars (Dodge Dart) and a high of 184 dollars (Chevrolet Corvette). There was a considerable range in the results within each body style and market class. Claim frequencies ranged considerably between market classes, from a low of 9.0 for compact models to a high of 16.0 for sports models. Average loss payments per claim were lowest for full size models and highest for sports. Detailed claim frequency data and average loss payment data are presented for each combination of driver age group (youthful and not youthful) and for 50 and 100 dollar deductible coverage for individual vehicles, for each market class, and for all vehicles.

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HS-018 141

AUTOMOBILE INSURANCE LOSSES COLLISION COVERAGES. VARIATIONS BY MAKE AND SERIES. 1973 MODELS DURING THEIR FIRST THREE YEARS

Variations in both frequencies and size of claims for damage to 1973 model year private passenger vehicles, including twelve domestic and one foreign make, during the period September 1972 through August 1975 were investigated. Data on insurance covering damage to the insured vehicles were supplied by the following insurance companies: Allstate; Kemper; Liberty Mutual, Nationwide, State Farm, and Travelers. Data are presented completely without discussion. The following tables are included: loss payment summary by make, series, and body style; loss payment summary by make, series, and body style by year of availability; claim frequency details by make, series, and body style by driver age group and amount deductible; and average loss payment details by make, series, and body style by driver age group and amount deductible. The data presented are based on almost four million insured vehicle years of exposure.

Highway Loss Data Inst., Watergate Six Hundred,
Washington, D.C. 20037
Rept. No. HLDI-R73-4 ; 1975 ; 33p 1ref
Availability: Corporate author

HS-018 142

DRINK-DRIVING PROPAGANDA IN SYDNEY, AUSTRALIA: EVALUATION OF FIRST STAGE, INFORMATION CAMPAIGN

A drink-driving campaign, intended to increase driver awareness, was instituted in Australia. The information campaign had three stated communications objectives: increasing awareness of the relationship between drinking and driving and serious traffic crashes; increasing awareness of the Breathalyzer legislation and the penalties contained in it; and increasing awareness of the amount of alcohol intake required to break the law. After the campaign, there was a measureable increase in knowledge in the three areas defined by these objectives. More people knew that alcohol was an important contributor to serious crashes; more people knew that the legal limit was .08 percent, and what the penalties for failing the breathalyzer included; and more people were aware that six drinks in an hour would bring the average man over the .08 percent level. With a few exceptions, the increases were uniform over the whole target audience. The campaign involved a six week press and radio campaign based on the theme "The law is tough on drinkers who drive." Fear tactics were carefully avoided. The campaign was aimed at drivers aged 17-69 years inclusive. Evaluation of the campaign was measured by means of a household survey conducted in the metropolitan area among 1000 randomly selected men and women both before and after the campaign.

by Kathleen Freedman; Michael Henderson; Rosamond Wood
Department of Motor Transport, Traffic Accident Res. Unit,
N.S.W., Australia
Rept. No. 2/75 ; 1975 ; 68p 7refs
Availability: Corporate author

HS-018 143

A SIMPLE METHOD FOR SIMULATING DANGER-RELATED ASPECTS OF BEHAVIOR IN HAZARDOUS ACTIVITIES

A dart-throwing game was devised to simulate the most important aspects of an assumed closed-loop system which is presumably involved in many forms of hazardous activity. This closed-loop system involves an agent who, to a large extent, determines the difficulty and dangerousness of a task and whose decision making reflects his prevailing excitatory and inhibitory motives. Five subjects threw standard darts at a rectangular target 60 centimeters in height and 180 centimeters in width from the distance of 4.0 meters. The target was divided into vertical sections. An extensive area on the left-hand side of the target yielded only small scores, while the scores became progressively higher in the right-hand direction. However, on the right side of the very narrow area giving the greatest score, there were two additional sections: a near-accident area yielding no score and, still more to the right, an accident area, which carried a penalty of 1,000 points. Two score gradients were used: a gentle gradient, in which the score increased only moderately when the near-accident area was approached and a steep gradient, in which the score increased steeply as the near-accident area was approached. The subjects participated in 16 daily sessions of 0.5 to 1.0 hours each performing with the gentle and the steep gradients on alternating days. Only three "accidents" occurred, but 999 near-accidents took place. The frequency of the near-accidents was higher with the steep gradient (10.28%) than with the gentle gradient (7.99%). The results show that a better throwing skill was accompanied by a pursuit of greater scores, indicating that safety is not necessarily increased by improving skill since the favorable effects of a smaller unintended variation of performance are lost because of a higher level of aspiration. A statistically significant effect of a near-accident on the subject's subsequent performance was found, demonstrating a remarkable warning effect of a near-accident on behavior. It is concluded that, because the subjective risk presumably is to a great extent dependent on warnings the individual receives from his behavior, it is essential to safety that warning is provided every time when risky forms of behavior occur.

by Risto Naatanen; Heikki Summala
Publ: Accident Analysis and Prevention v7 n1 p63-70 (May 1975)
1975 ; 8refs
Supported by the Res. Council for the Humanities of the Finnish Academy.
Availability: See publication

HS-018 144

FUNCTION OF THE MUSCLES OF THE UPPER LIMB IN CAR DRIVING. 4. THE PECTORALIS MAJOR, SERRATUS ANTERIOR AND LATISSIMUS DORSI MUSCLES

The function of the pectoralis major, serratus anterior, and latissimus dorsi muscles were tested electromyographically during driving in a simulator. The aim was to test whether the clavicular and sternocostal portions of the pectoralis major, the serratus anterior, and the latissimus dorsi muscles work when moving a steering wheel, and if so, during which parts of the movement the different muscles work, and to determine

drivers aged 20-36 years. The pectoralis major muscle seemed to stabilize the shoulder during car driving, the clavicular portion being more active than the sternocostal. The serratus anterior muscle worked in contralateral rotation of the steering wheel. The latissimus dorsi muscle was active only to a small extent, and when activity occurred it was usually in ipsilateral rotation of the steering wheel.

Y. S. Jonsson; B. Jonsson
 Publ: Ergonomics v18 no p643-9 (Nov 1975)
 1975 : 7refs
 See also HS-017 335.
 Availability: See publication

HS-018 147

REVIEW OF SUCCESSFUL FUEL CONSERVATION MEASURES FOR MOTOR VEHICLE FLEETS

Methods which can be used to reduce the fuel consumption of motor vehicle fleets are reviewed. Fleet operators should develop their own minimum vehicle operating weights and police this by regular weigh-scaling of their vehicles, since a weight increase of 100 pounds means a loss of some 0.5 to 0.6% in fuel mileage. Tools and parts carried on field service vehicles should be kept to a minimum. Every component of the engine and driveline system should be examined carefully with a view to selecting the best fuel mileage combination when purchasing a new vehicle. Purchase of tires designed and constructed to reduce the rolling resistance of the vehicle will increase fuel economy and tire life. Every effort should be made to maintain pollution control devices on the vehicles in design working order in order to minimize losses in fuel economy. New types of ignition systems now available may have some effect on fuel economy, but further investigation is required. Options and accessories, especially those which take power from the engine either directly or via the electrical system, usually cause lost fuel mileage. Only those items for which there is a demonstrated need should be provided in fleet vehicles. Options which enhance fuel mileage include speed control options, mileage meters based on the manifold vacuum gauge, and the radiator shutter. A comprehensive fleet maintenance program is essential to improved fuel economy. Unnecessary idling of the engine when the vehicle is standing must be avoided.

by S. E. Swallow
 Ford Motor Co. of Canada Ltd.
 Rept. No. SAE-750072 : 1975 : 10p 9refs
 Presented at the Automotive Engineering Congress and
 Exposition, Detroit, Mich., 24-28 Feb 1975.
 Availability: SAE

HS-018 148

THE ELECTRIC MULTISTOP FLEET DELIVERY VEHICLE-FACT OR FANTASY

The Electric Vehicle Council (EVC) Electric Truck Program has created a breakthrough in multistop electric delivery work vehicle performance. Freeway speeds can be maintained for normal cross-town or bypass travel between point of origin and urban use, greatly extending the flexibility needed to gain the cost saving advantages of an electric work vehicle. A total of 108 vehicles are now in operation throughout the United States and Canada. Records show savings in fuel energy costs

with the increased gas and/or diesel fuels consumed by the multistop fleet delivery vehicles now available with 1975 Environmental Protection Agency (EPA) pollution control devices. EPA standards call for the devices to function properly with nominal engine idling time while stopped for 10 percent of the driving cycle, whereas the majority of multistop fleet delivery vehicles operate with nominal engine idling time of 50 percent or greater during traffic and work route driving cycle. The impact of increased first cost for pollution control devices, plus the increased fuel cost, and much higher service and maintenance costs should cause fleet operators to examine the facts presented about the electric multistop fleet delivery vehicles, which can be used now with substantial increase in non-polluting efficiency in urban areas. Photographs of a variety of electric delivery vehicles are provided and an EVC inspection report, test report, and lists of vehicle locations and uses, specifications, and manufacturers are appended.

by Paul R. Hafer; Arthur Dicker, Jr.; Harry D. Yoder
 Batronic Truck Corp.; Boyertown Auto Body Works
 Rept. No. SAE-750075 : 1975 : 18p 7refs
 Presented at the Automotive Engineering Congress and
 Exposition, Detroit, Mich. 24-28 Feb 1975.
 Availability: SAE

HS-018 149

A STATEMENT OF NATIONAL TRANSPORTATION POLICY BY THE SECRETARY OF TRANSPORTATION, SEPTEMBER 17, 1975, WASHINGTON, D.C.

The Federal Government has actively participated in building the infrastructure of the transportation system in the United States (U.S.). It has also assumed responsibility to ensure the safety of travellers, to protect the public from the abuse of monopoly power, to promote fair competition, to develop or continue vital transportation services, and to balance environmental, energy, and social requirements in transportation planning and decision making. The U.S. Department of Transportation (DOT) will continue to emphasize comprehensive planning and multimodal solutions in its attempts to improve passenger and freight transportation service by air, water, truck, bus, and rail across the United States. In addition, efforts will be concentrated on making more effective, intelligent, and socially responsible use of the private automobile, and on protecting society against the adverse impacts of transportation. Specific goals of the national transportation policy include: allocation of Federal resources more fairly among the modes of transportation; resorting to subsidies only when a clearly defined national interest requires the development, modernization, or maintenance of essential transportation service; reformation of the regulatory structure to remove out-moded constraints on competition among carriers and modes; development of incentives for more efficient intermodal services; identification and elimination of unreasonable barriers to intermodal cooperation; improvement of information bases, measures of performance, cost-benefit methodology, and planning and program evaluation capability in order to respond more efficiently to transportation needs and to understand the indirect effects of DOT actions; and recognition of the need for a fair return on capital by the private sector providers of transportation services and the need for sound fiscal responsi-

bility in the provision of transportation services supported by public funds.

by William T. Coleman, Jr.
Department of Transportation, Washington, D.C.
1975 ; 54p 1ref.
Availability: GPO \$1.15, stock no. 050-000-00103-2

HS-018 151

REGULATIONS AND TRANSPORTATION. REPORT OF THE THIRD WORKSHOP ON NATIONAL TRANSPORTATION PROBLEMS

A workshop on Regulations Affecting Transportation was held in February 1975 as part of a continuing series of workshops designed to develop information useful to U.S. Department of Transportation (DOT) policymakers through interaction between principal investigators in universities under contract to DOT and DOT officials responsible for programs affected by government regulations. The principal topics covered in the workshops were: ratesetting processes affecting cost and prices; regulations set by DOT for safety and security; regulation research and evaluation; and regulation and data requirements. The participants recommended that the regulatory structure be improved through the introduction of modern systematic management methods, such as statistical methodology and performance standards, and that DOT should speedily develop proposals for changes affecting rates and services. Research related to the relaxation of regulatory controls should include market studies and social benefit analysis. Data collection and analysis activities should be coordinated with regulatory objectives to provide effective means for measuring and predicting the impact of existing and proposed regulations and shaping regulatory policies. An inventory of available data should be prepared. Specific areas of safety and security covered by the workshops included: boating safety standards; highway safety standards; motor carrier safety; national highway traffic safety; and civil aeronautics security.

Office of Univ. Res., Office of the Secretary of Transportation, Washington, D. C. 20590
Rept. No. DOT-TST-75-79; PB-242 292 ; 1975 ; 108p
Includes addresses by DOT officials entitled: Economic Regulation of Transportation—Do We Need It?; Regulation in a Hot Kitchen; Reflection on Activities of the National Transportation Safety Board; Regulations—Systems Effect or Noise?; and The Automobile—Interaction of Energy, Safety, and Environment, and the Economy.
Availability: NTIS, \$5.25

HS-018 152

HOW SAFE IS YOUR RV?

As the numbers of recreational vehicles in use increases, accidents related to lack of safety knowledge are also increasing. Many states have passed legislation banning riding in a towed house trailer. Although no firm proposals for federal regulation of these vehicles have yet been adopted, National Park Officials have placed some new restrictions on the use of camper units in parks, and various other controls are currently under consideration. Safety checks and precautions which travellers with recreational vehicles should observe include: check the condition and air pressure in the tires; do not overload and make sure the load is balanced; check for leaks in the fuel feed line connecting the tank to the stove; tighten wheel lug bolts before starting on a trip; check the trailer bearings every

1,000 miles to assure proper lubrication; check the hitch tightness every 100 miles; make sure side-view mirrors provide a clear view of the rear; use lower gears for down grade; make sure trailer lights are connected and operating properly; carry a fire extinguisher; and make sure side mirrors comply with federal regulations. It is stressed that most drivers are inexperienced in towing campers or trailers, and that driver behavior is a more serious problem in accidents involving recreational vehicles than are mechanical failures.

by William Roper
Publ: California Highway Patrolman v39 n6 p6-7, 32-3, 36-7, 40-2 (Aug 1975)
1975

Availability: See publication

HS-018 153

A SELF-ADMINISTERED SHORT MICHIGAN ALCOHOLISM SCREENING TEST (SMAST)

The Michigan Alcoholism Screening Test (MAST) and a shortened 13-item version (SMAST) were devised to provide consistent, quantifiable, structure interview instrument to detect alcoholism. Originally consisting of 25 questions administered in 10 to 15 minutes, a total of 501 male drivers over age 20 completed the questionnaire—102 after routinely receiving their driver licenses, and 171 drivers who had been sent to driver safety school by the courts following conviction for one or more moving violations. The distribution of SMAST scores was similar to the distribution of MAST scores. The percentage of subjects scoring 0-2 and 3-13 on the SMAST was most the same (less than 5 percent difference) as the percentage of subjects on the MAST. It is suggested that subjects scoring 0-1 can be considered nonalcoholics, 2 points possible alcoholics, and those with 3 or more points alcoholics. The questions considered diagnostic on the MAST would remain on the SMAST. Scoring norms thus assure finding a high proportion of alcoholics. It should be remembered that the use of SMAST and MAST is for screening devices rather than for diagnostic instruments.

by Melvin L. Selzer; Amiram Vinokur; Louis van Rooijen
Publ: Journal of Studies on Alcohol v36 n1 p117-26 (Jan 1975) ; 12refs

Availability: See publication

HS-018 154

DETAINING THE IMPAIRED DRIVER

A number of studies conducted on the relationship between drinking and impaired driving behavior demonstrate that as risk levels rise with the level of blood alcohol concentration (BAC), and that in certain groups (those drivers 18-19 years old and over 70 years old), even a small amount of alcohol in the blood can cause a significant impairment in driving ability. A number of states have enacted legislation making it a misdemeanor for a person to drive while impaired, and use of measurement of a BAC reading above .10 percent as presumptive evidence of such impairment. The use of the impairment denotes a driver whose operation of an automobile can be detected as unsafe by a law enforcement officer. In most states under present conditions, a driver who is found to be impaired on the highway is usually allowed to continue to operate the motor vehicle. Several states and the District of Columbia are now seeking to establish centers to deal with the rehabilitation

of alcoholics, and to decriminalize public intoxication. Individuals found in an inebriated state are taken to detoxification centers until it is decided that the person is capable of driving safely. The question of manpower has found at least a partial solution in the suggestion that convicted drinking drivers could serve as hosts and hostesses at the detainment facilities for a specific number of evenings. They would perform such tasks as keeping records, serving coffee, showing films, and distributing literature.

by Marvin H. Wagner
Publ: Traffic Safety v75 n10 p8-10, 35-6 (Oct 1975)
1975
Availability: See publication

HS-018 155

SINGLE VEHICLE ACCIDENT RELATIONSHIPS

A study was recently completed at the Georgia Institute of Technology on the relationships between single-vehicle, off-road, fixed-object accidents and traffic, roadway design, and socioeconomic characteristics. Crashes in which an out-of-control vehicle struck an off-road, fixed object and then overturned were included, but not crashes in which the involved vehicle left the roadway to avoid another vehicle. Forty-five sections of arterial and collector two-lane streets in Atlanta, Georgia, were selected for the study. Roadway and traffic data for two-lane urban streets may be grouped into the following four categories: the class of roadway, which is closely related to average daily traffic, pavement width, and speed limit; a roadside factor, characterized by the number of driveways and discrete and continuous fixed objects along the roadside; a design feature category, including horizontal and vertical alignments of roadways; and a land-development factor, which is correlated to the number of intersections. Socioeconomic variables, which are closely interrelated and best represented by population density, were not found to be significantly related to off-road accident rates. Multiple regression analysis of the data showed that off-road accidents per mile are most closely related to average daily traffic, horizontal alignment, and number of intersections per mile. On a per-million-vehicle miles basis, only average daily traffic and horizontal alignment were found to be significantly related, but the rate of off-road accidents per million vehicle miles decreases with increases in traffic volume. Although significant regression models relating off-road accident rates to roadway and traffic characteristics were developed, these variables can explain only about 26 to 41% of the variations in off-road accident rates.

by Paul H. Wright; King K. Mak
Publ: Traffic Engineering v46 n1 p16-21 (Jan 1976)
1976 ; 12refs
Partially supported by the National Hwy. Traffic Safety Administration. Prepared in cooperation with the Georgia Dept. of Transportation and the Atlanta Police Dept.
Availability: See publication

HS-018 156

THE 55 MPH SPEED LIMIT: A COST/BENEFIT ANALYSIS

A cost/benefit analysis of the 55 mph speed limit was conducted using fuel consumption and accident data from 1974. Costs analyzed were the value of the time lost by reducing maximum speed from 70 mph to 55 mph. Three types of

benefits were calculated: the value of gasoline saved, lives saved; and injuries averted. Benefit/cost ratio calculations show that the ratio of initiating the 55 mph speed limit for automobiles is .823, indicating that costs outweigh the benefits. Analysis of the sensitivity of the benefit/cost ratio to the specific major variables indicates that a benefit/cost ratio of 1 would result from: a 17.7% reduction in the value of time lost; a 35.9% increase in the value of gasoline saved; a 106% increase in the value of lives saved; or a 105% increase in the value of injuries averted. The most likely route for achieving a benefit/cost ratio of at least 1 lies in a relative increase in the value of gasoline savings. The other major variables derive their values from the structure of the total economy, while gasoline savings are a function only of automobile mileage at different speeds and the price of gasoline. A wide range of events could effect the desirability of a 55 mph speed limit. It is suggested that a need exists for greater research on the consequences of proposed legislative actions to avoid laws such as the 55 mph speed limit which do not provide an overall beneficial effect.

by Gilbert H. Castle, 3rd.
Publ: Traffic Engineering v46 n1 p11-14 (Jan 1976)
1976
Availability: See publication

HS-018 157

ANTHROPOMETRY OF U.S. INFANTS AND CHILDREN

A three-year study was designed to collect, analyze, and reduce selected anthropometric data on 4,027 infants and children representative of the current U.S. population ranging in age from newborn to 12 years of age. The major purpose of the study was to provide basic measurement data most useful and critical to consumer product design, regulatory consideration, or other direct applications. A substantial portion of the study involved the design, fabrication, development, and testing of a new series of anthropometric measuring devices which transmit measurement signals to a portable mini-computer data acquisition system or to a set of readout meters. These devices include highly modified anthropometers and calipers for linear measurements and a hand-held girth measuring device for circumference measurements. A pressure transducer has been incorporated in the moving paddle blade of the calipers and anthropometers in order to achieve greater reproducibility in making soft tissue measurements on infants and small children where immature skeletal development often precludes use of standard adult landmarks. Numerous specialized devices to measure inside and outside grip dimensions, finger diameters, and minimum hand-through-hole diameters have also been developed. In addition, two sizes of portable center-of-gravity devices designed during the study are capable of instantaneously measuring seated or standing centers of gravity. These instruments have been incorporated for use with a Nova 1220 mini computer to provide a completely automated anthropometric measurement system for the majority of measurements taken. Each of the 41 measurements developed and used in this study is defined and illustrated, and tabular charts are provided listing the mean, standard deviation, 5th, 50th, and 95th percentiles by age and sex, and for combined sexes.

In addition, the mean, 5th, and 95th percentiles are shown graphically.

by Richard G. Snyder; Martha L. Spencer; Clyde L. Owings; Lawrence W. Schneider
University of Michigan
Contract FDA-72-70
Rept. No. SAE-SP-394; SAE-750423 ; 1975 ; 242p 91refs
A summary of this report was presented at the SAE
Automotive Engineering Congress and Exposition, Detroit,
Mich., 28 Feb 1975.
Availability: SAE

HS-018 158

TRANSPORTATION FOR THE HANDICAPPED. SELECTED REFERENCES

A selected, partially annotated listing of journal articles, papers, and reports on the subject of transportation for the handicapped is presented covering the period 1969 through 1974. In addition to general materials, specific areas covered by the bibliography include: government activities; accessibility; air travel; mass transit; automobile drivers and parking; special equipment, including vehicles and assistive aids; transportation and the blind; and transportation and the elderly. Over 200 article, report, and/or paper references are included.

Department of Transportation, Library Services Div.,
Washington, D. C. 20590
Rept. No. Bib-List-8 ; 1975 ; 46p
Update of Bibliographic List no. 1, Nov 1969.
Availability: Corporate author

HS-018 159

COMPARISON OF THREE TYPES OF FRONT BODY CONSTRUCTION OF SUB-COMPACT CARS

Three different types of front suspension and the corresponding body construction configurations were selected for comparison among unitary constructed sub-compact cars with a weight range between 2,500 pounds and 3,000 pounds which are currently being manufactured by Toyota Motor Company. The front suspension systems studied include: Type A, which is the McPherson type used in Celica models; Type B, which is a double wishbone type suspension consisting of upper and lower "A" arms and a coil spring mounted directly on the front fender apron used in the Corona; and Type C, which is a double wishbone type suspension consisting of an upper "A" arm and a lower arm having a strut bar and mounted on the front body through rubber insulating mounts used in the Corona Mark II. A comparison was made among the three models in terms of weight, productivity, noise and vibration characteristics, and crashworthiness differences which are attributed mainly to the type of front body construction. Analysis of the weight as determined by the load-sustaining and transmitting characteristics of each model shows that Type A is the lightest and Type C the heaviest. Productivity, as measured by the number of steps in the stamping process, the

A construction has longer deformable areas than Types B and C and is a fundamentally desirable structure with greater capability for improving the crushability of the side member without upsetting the weight priority than the other types. It is concluded that Type A is the safest structure, followed by Type B and then Type C. While Type B is almost at the same level as Type A, Type A has greater potential for improving crashworthiness. Overall, it is concluded that the Type A front body configuration is the most desirable, followed by Type B and then Type C.

by Akihiro Wada; Masahiko Inove
Toyota Motor Co.
Rept. No. SAE-750076 ; 1975 ; 11p
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 160

MANDATORY MOTORCYCLE HELMET STATISTICAL ANALYSIS AND SAFETY STUDY

A study was conducted by the California Office of Traffic Safety to: document the statistical effect of mandatory motorcycle helmet legislation in the 44 States that have enacted legislation; compare the motorcyclist death and injury statistics of States with mandatory motorcycle helmet legislation with those without such legislation; and provide in one report an overview of the state-of-the-art on motorcycle accident victims in the United States. The following sources of information were used: questionnaires completed by other States; California Highway Patrol accident records; and motorcycle accident literature. The upward trend in motorcycle fatal accidents on a nationwide basis over the past several years is attributed to the increased popularity, registration, and exposure of motorcycles. California was found to have about the same fatality to injury accident rate as the 25 reporting States with motorcycle helmet legislation. California's three year fatal motorcycle accident rate per 10,000 registered motorcycles from 1967 through 1970 was found to be only slightly higher than the average for the same period of the 11 States which were able to provide enough information to compute the ratio. Preliminary statistics for 1973 indicate a 6% to 11% decrease in California motorcycle fatalities. It is concluded that there are no stable statistical trends to document that mandatory motorcycle helmet legislation will reduce the number of motorcycle accident fatalities, the motorcyclist fatality to injury ratio, or the fatal accidents to 10,000 registered motorcycle ratio. In addition, motorcycle injury and fatality statistics are judged to be inadequate at the State level to make valid statistical inferences of the benefits of mandatory motorcycle helmet or other motorcycle safety legislation. Greater emphasis needs to be placed on the collection of motorcycle accident data if effective safety programs are to be developed.

California Office of Traffic Safety
1974 ; 37p 25refs
Availability: Corporate author

HS-018 161

A REVIEW OF PHILOSOPHICAL CONSIDERATIONS IN THE DEVELOPMENT OF RADAR BRAKE SYSTEMS

The National Highway Traffic Safety Administration (NHTSA) has been involved in an investigation into the economic and technical feasibility of applying radar devices as sensors for automatic braking systems. Several different system application philosophies have been defined and discussed with consideration being given to the expected economic and safety benefits afforded by each. A total of ten different system types having different combinations of system characteristics such as driver warning only, non-cooperative (normal radar), cooperative (specially tagged targets), automatic brake actuation, two-wheel anti-lock, and four-wheel anti-lock were evaluated in terms of the degree of certainty with which 104 actual accidents could have been either prevented or reduced in severity. It was determined that a hypothetical noncooperative, automatic brake activating, four-wheel anti-lock system would have prevented from 14 to 41% of the accidents and would have reduced the severity of from 4 to 12%. Other systems were judged to be theoretically less effective. Analysis of other accident files indicated that an automatic, noncooperative system would have prevented 46% of all rear-end collisions, 28% of all head-on accidents, and 10% of all pedestrian, intersection, and fixed-object accidents. Based on estimated systems costs, only noncooperative designs were concluded to be cost effective. A technical feasibility study of radar brake systems investigated such topics as radiation hazards, intersystem blinding effects, performance restrictions imposed by common highway geometries, the effects of precipitation on signal propagation, and analysis of vehicular radar cross sections. Results obtained to this point have not indicated that there are any major technical obstacles which would preclude the development and eventual production of radar sensors for automatic braking systems. A number of technical difficulties will have to be resolved before such systems become marketable, but no insurmountable problems have been identified. Signatures of typical targets indicate that all of the selected targets, including pedestrians and cyclists, are detectable. Significant problems include the effects of highway geometry, intersystem blinding, and the effects of rain scattering and attenuation.

by R. A. Chandler; L. E. Wood; W. A. Lemeszewsky
Department of Commerce; Department of Transportation
Rept. No. SAE-750086; 1975; 18p 14refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 162

DUAL-MODE AUTOMOBILE COLLISION AVOIDANCE RADAR

A dual-mode version (cooperative and noncooperative) of Shefer's collision avoidance radar using second harmonic reflectors is proposed. The cooperative mode of the dual-mode radar is based on tagging cooperating vehicles and other potential highway hazards with modulated fundamental frequency reflectors, rather than with harmonic reflectors. When operat-

harmonic radar. In addition, modulated fundamental frequency reflectors make simpler electronic license plates than harmonic reflectors. The dual-mode radar also recognizes targets that do not carry tags, but at much shorter distances than the range for cooperating targets. The range of the radar when looking at tagged targets is about 100 meters. The dual-mode radar system consists of three sections: a radar frequency (rf) section consisting of an rf transmitter, an antenna, and an rf receiver; a baseband section that evaluates and processes the radar returns; and an alarm and control section.

by G. S. Kaplan; F. Sterzer
Radio Corp. of Amer.
Rept. No. SAE-750087; 1975; 6p 3refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 163

FERROUS FOUNDRY INDUSTRY LONG-RANGE OUTLOOK FOR RAW MATERIALS

Over the past several months there has been a short supply of raw materials for the ferrous castings industry, which produces many of the parts used in automobiles. The major raw materials needed by the industry are ferrous scrap, pig iron, ferroalloys, and carbon raisers. Process materials include electrodes, refractories, molding materials, and binders. Energy materials used to melt and process metal are principally electric power, coke, and natural gas. Many of these materials have been in short supply lately, in some cases seriously affecting production. Although the supply of these materials currently seems to be improving, the supply outlook for energy materials does not look good. The real problem for the automotive industry and its need for ferrous castings is not only the inadequate supply of raw materials, but the lack of sufficient foundry capacity to meet the demand for castings. This shortage of production capacity has resulted from pollution control laws and low profitability. Many furnaces used to produce ferrosilicon from a readily available and adequate supply of raw materials have been shut down because they were too small or too old to justify pollution control investment. The generation of heat and power have also been seriously impeded by environmental controls. Rising costs and shortages of materials imported from other countries have also caused problems in the industry. Efforts must be made to improve trade relations with the resource-rich countries. Many small ferrous castings foundries have been forced to close down as a result of pollution control laws, and low profitability has retarded needed expansion and modernization of existing foundries.

by George A. Watson
Ferroalloys Assoc.
Rept. No. SAE-750100; 1975; 7p
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

THE IMPACT OF THE ENERGY AND MATERIALS RESOURCE PROBLEMS ON POWDER METALLURGY

The powder metallurgy industry, which produces many metals used in automobile manufacture, has faced a variety of material and energy shortages in recent years. The industry uses several atmosphere gases, the most important of which is ammonia, which is used to create the reducing atmosphere needed in sintering. Shortages of ammonia are expected between now and at least 1978. This shortage can be met by increasing recycling of ammonia and by using other atmospheric gasses with lower energy content. Graphite, a material which is critical to powder metallurgy, is available in sufficient quantities from foreign countries, but prices are rising rapidly. Recent shortages in metal powders, including ferrous scrap, copper and copper base powders, and nickel powder, appear to be mostly under control at this time. Prices for metal powders are somewhat more stable than in the recent past and capacity seems to be expanding slightly for most of these materials. Powder metal parts manufacturing capacity is adequate to meet demand for these products, assuming the raw materials are available. Both metal powders and process materials for this industry appear to be available in sufficient quantity at this time. The powder metallurgy process minimizes energy expenditure during the conversion of raw materials into finished products. In addition, most metal powder producing processes are in fact recycling systems, using scrap metal as a major raw material. The automotive industry has recently developed an increased interest in the use of powder metallurgy processes and products in an effort to conserve energy. Powder metallurgy eliminates the energy requirements of melting and does not generate scrap in making the finished product.

by Kempton H. Roll
Metal Powder Industries Federation
Rept. No. SAE-750101; 1975; 10p
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

VEHICLE TO VEHICLE COLLISIONS UTILIZING ENERGY ABSORBING UNITS

A study was conducted to determine the feasibility of using shock absorbers to decrease the aggressivity of the large car towards the small car during a car-to-car collision at 40 mph. In principle, this reduction of aggressivity of the large car implies that the large car be crushed more during impact, thus reducing the impact load transmitted to the small car. The analytical-experimental technique used to predict the collapse of two colliding vehicles equipped with energy absorbing units involved the use of simulated vehicles consisting of lumped masses interconnected with hysteretic plastic and elastic elements and absorbing units. Experimental data used as input to the mathematical model consisted of the static force versus crush characteristics of eight forestructural elements. The crushable plastic elements considered were: the sheetmetal

absorbers throughout the initial speed range. Decreased aggressivity of the larger car was clearly demonstrated. Increase of the shock stroke was found to cause the large car to be crushed more in car-to-car collisions at speeds below 25 mph. It was also found that: the small car is generally accelerated and crushed more severely than the large car; peak g load and average acceleration of the small car is reduced most significantly using shock absorbers at speeds below 20 mph; shocks eliminate firewall crush in the large car; shocks increase upper load path and center load path crush; and shocks decrease the lower load path crush of the small car.

by R. M. Krupka; A. B. Krueger
Chrysler Corp.
Rept. No. SAE-750110; 1975; 16p 2refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

LARGE AND SMALL CAR ACCIDENT PERFORMANCE: A LARGE SCALE ACCIDENT DATA BASE ANALYSIS

New York State has developed a system for examining relationship between vehicle design and traffic crash incidence and injury severity which uses a large volume accident data base, including information from the appropriate vehicle registration file, driver license file, and accident statistics file. Data from these separate files are merged to form an integrated data base. This data base made possible a study of the relationship between small car and large car accident performance. Accident involved vehicles were studied using such variables as make, model year, shipping weight, and horsepower, and accident data such as impact area, road conditions, and seat belt use. Severity of injury was measured by the percent of the accident-involved vehicles in which a fatal or serious injury occurred. The accident rate was measured by the number of accidents per thousand vehicle registration months. Analysis of two-car collisions demonstrated the relative superiority of the full size automobile. The percent of fatal and serious injury to the accident-involved driver not using a seat belt consistently diminishes as the weight of the vehicle increases. Also, as a given vehicle is in collision with vehicles of progressively heavier weights, the severity increases, but not of comparable magnitude and consistency. The only major exception to this pattern occurred when the study vehicle weight was smallest (between 1,000 and 1,999 pounds), in which instance the injury severity rate was just as high when in collision with another light vehicle as with any heavier vehicle. An overall reduction in the percent of fatal and serious driver injuries was demonstrated when seat belts were used compared to accidents where seat belts were not used. Seat belts were found to contribute to injury reduction even in the smallest cars.

by Basil Y. Scott
New York State Dept. of Motor Vehicles
Rept. No. SAE-750113; 1975; 8p
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

COMPATIBILITY BETWEEN BIG AND LITTLE CARS

Hybrid front end car design provides a straight forward approach to achievement of compatibility during crashes between the smallest and largest cars, as well as all other sizes in between these extremes. Compatibility means optimal conditions for occupant survival in frontal, side, and rear collisions through a broad range of closure speeds and potential obliquities. Hybrid front ends consist of designs producing primary load paths through short stroke, self force regulating hydraulic cylinders in series with crushable structure. Computer simulations of hybrid vehicles (with occupants) impacting fixed rigid barriers were conducted. Data on the vehicle and occupant displacements during a 45 mph barrier crash simulation of a design hybrid car show that the occupant motion relative to the passenger compartment ceased before the vehicle stopped. Simulations of aligned head-on crashes between vehicles of different weight were also conducted to verify the validity of apportionment of hydraulic stroke contribution to total crash energy absorption in the larger hybrid vehicles. In each case a vehicle weighing between 2,000 and 5,000 pounds was impacted against a vehicle weighing 1,500 pounds. These computer runs at design closing speeds confirmed the proper allotments of vehicle energy absorption, showing crush in the lightest vehicle equal in magnitude to that produced in fixed rigid barrier impact. It is concluded that the hybrid front end design can achieve compatibility over wide ranges of colliding vehicle mass ratios. The hybrid design approach offers the advantage of lowest required front end crush dimensions to achieve any desired compatibility level. It provides assurance of efficient energy absorbing front end crush at load levels produced by the crushing load level history of the other vehicle if its structure is weaker than the supporting structure of the hybrid.

by Jerome M. Kossar
National Hwy. Traffic Safety Administration
Rept. No. SAE-750114; 1975; 14p 6refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 168

HOW MUCH SAFER ARE YOU IN A LARGE CAR

A study was conducted to develop estimates of the national distribution of fatalities classified by four age groups and two vehicle size groups. The vehicle sizes used were large cars, defined as standard model automobiles, and small cars, defined as compact and sports models. Data from 16,003 accidents involving these cars sizes contained in the 1972 Texas sample file were used for this analysis. This sample file represents a regular sample of 5% of all involvements of cars of those sizes which were reported by police departments in Texas during 1972. An Automatic Interaction Detector (AID) computer program used the dichotomous vehicle size as the dependent variable and the following predictor variables: vehicle damage area; damage extent; driver age group (16-24, 25-34, 35-54, and 55 and over); driver sex; and driver injury severity. The results of the analysis show that the probability of receiving a fatal injury is greater in small cars than it is in large cars. Small cars are disproportionately more lethal to older drivers than large cars, evidently because of the older driver's sensitivity to injury, since older drivers are involved

predominant increase in injury with age is in the chest, shoulder, and upper back areas.

by James O'Day; Richard Kaplan
Highway Safety Res. Inst.
Rept. No. SAE-750116; 1975; 14p 2refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 169

EFFECT OF VEHICLE MIX ON TWO-CAR HEAD-ON IMPACT

The comparative dynamic response of two cars differing in mass and structural characteristics and impacting head-on was examined for various closing speeds and payloads through the use of a computer simulation model. Dynamic response factors include acceleration, velocity, and crush characteristics. The closing speed, tire friction, weights, and structural characteristics of the two cars impacting were found to affect the impact responses and, in particular, the relative amounts of impact energy dissipated by each vehicle. Because of this, vehicle response during car-to-car impact generally differs from that of barrier impact. For a given pair of vehicles, the deceleration history following head-on impact was found to depend on the closing speed rather than on their absolute velocities. The duration of impact was found to be fairly insensitive to impact speed for a given pair of cars. Head-on impact of two cars which are not identical results in a bumper-level crush distance generally different from the sheet metal crush, and may vary as a function of closing speed. As a result of the nonlinearity of vehicle crush characteristics, the fraction of total impact energy dissipated by each car varies as a function of their closing speed, except in the case of collision of identical vehicles, in which case each vehicle dissipates half of the total impact energy. The dynamic impact response of a vehicle was found to be affected much more by changes in its own body weight (passenger load, luggage load, and options) than by corresponding changes in the weight of the car it impacts. Increases in the body weight of a given car undergoing head-on impact have the effect of shifting the acceleration spikes to earlier in the impact. The development of the mathematical simulation model and a mathematical description of the characteristics of resistances are appended.

by Kuang-Huei Lin; Mounir M. Kamal; J. William Justusson
General Motors Corp., Res. Labs.
Rept. No. SAE-750117; 1975; 16p 10refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 170

AN INVESTIGATION OF INTEGRATED RETARDER/FOUNDATION BRAKE SYSTEMS FOR COMMERCIAL VEHICLES

The potential usefulness of commercial vehicle brake systems which integrate a hydrodynamic retarder into the foundation brake system was investigated. A hydrodynamic retarder is a device that utilizes viscous damping as mechanism for retarding the vehicle. The damping fluid is cooled by means of the engine radiator or a separate cooler in the case of a retarder

equipped trailer. It is suggested that the hydrodynamic retarder, when properly integrated into the foundation brake system, will absorb as much as 90% of all braking energy in typical-effectiveness stops for frame vehicles, and as much as 30% in the case of a retarder equipped tractor-semitrailer combination. Analysis of the temperature response of foundation brakes currently used on commercial vehicles indicates that lower temperatures and less fade can only be achieved through lower values of braking energy, and thus, less vehicle weight and speed, or through increased levels of cooling capacity. Present foundation brake designs do not allow economical increases in convective cooling coefficient or cooling area. However, depending on the downhill operating conditions, the proposed retarder may absorb all or a portion of the vehicle braking energy. For economic reasons, the retarding capacity must be a function of intended vehicle use, traffic conditions, and other related factors. If the retarder/foundation brake system is designed such that for any braking requirement the hydrodynamic retarder is applied and then the foundation brake, a truck brake system may be developed which will provide essentially fade free brakes and significantly extended brake lining life. Foundation brakes weighing about 40% less than present systems may be installed, since temperatures will not increase during downhill braking, due to the absorption of nearly all continued braking energy by the retarder. This weight savings will more than compensate for the additional weight of the retarder. It is suggested that additional optional procedures in federal braking standards are needed to encourage the early development of safer commercial vehicles. A future combination of integrated retarder/foundation brakes with wheel-antilock control appears to be the ultimate in commercial vehicle transportation safety.

by Rudolph Limpert
University of Utah
Rept. No. SAE-750126 ; 1975 ; 10p 36refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 171

THE DESIGN AND TESTING OF A COMPLETELY WATERPROOF ELECTRICAL CONNECTOR FOR AUTOMOTIVE USE

The requirement for a completely waterproof electrical connector in automobiles was necessitated by the increased use of electronic circuits requiring high circuit-to-circuit insulation resistance. New approaches in materials selection and assembly methods were needed to meet connector design objectives in terms of temperature range, sealing ability, and ease of manufacture and assembly. The following aspects of the design objectives are described: temperature range; waterproofing; electrical capability; terminal locking reliability; terminal mechanical locking ability; terminal alignment; connector registration; connector polarization; minimum number of functionally critical features; manufacturing feasibility; assembly feasibility; external connector or terminal projections; terminal and connector strength to resist rough handling; shipping protection; connector mating force; terminal mating force; connector lock feature; wire accommodation; terminal separation; terminal serviceability; and post-molding. Following the tooling of the parts, a test apparatus was built to test each of the sealing

improved parts were again tested separately and as a total unit. The final connector was found to completely seal out surface water with soap as a wetting agent. The seals can be assembled automatically and the connection can be made by unskilled personnel with no special tools and with the high degree of reliability required by the automotive industry. The system will maintain the seal over a temperature range of -40 F to 300 F. Economics are in line with other automotive type connectors.

by Ronald F. Froats
Ford Motor Co.
Rept. No. SAE-750137 ; 1975 ; 8p
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 172

SURE-SEAL ENVIRONMENTAL CONNECTORS FOR AUTOMOTIVE ELECTRONICS

A new series of environmentally-sealed connectors has been developed for automotive use. They are presently being used on truck anti-skid brake control systems. The connectors prevent the entry of moisture and dirt, and are resistant to hydrocarbon fluids used in and around motor vehicles, such as gasoline, motor oil, transmission fluid and other lubricants. The operating temperature is from minus 40 degrees C to plus 105 degrees C. Stamped tin-plated contacts are supplied on reels for semi-automatic termination. The connectors plug into a sealed skid-control housing and mate with a matching header. The standard Sure-Seal connector consists of two, three and four pin connectors. Sealing boots for jacketed cables can be supplied. Special purpose connectors are also being made to fulfill specific requirements.

by David S. Goodman; Edgar Burns
ITT Cannon Electric
Rept. No. SAE-750138 ; 1975 ; 8p
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 173

ANAEROBIC ADHESIVES FOR SHEET METAL ASSEMBLY

Anaerobic structural adhesives have been developed for use in many fields. Information regarding one anaerobic structural adhesive which is designed to be used in a production environment for aluminum and steel sheet fabrication is presented. The product was tested for durability, and tests were performed on production-type surfaces. The tests included heat aging, humidity resistance, weatherometer testing, and fatigue testing. It was found that the adhesive can be applied to vertical and overhead surfaces without sagging; the product has an indefinite open time; the product will work on mildly contaminated surfaces; the product comes ready to use and can be dispensed from an air-operated caulking gun; and the product, once applied, will not migrate prior to or during heat

curing. The product is called LO215 and is manufactured by Loctite Corporation.

by Charles L. Karnolt
Loctite Corp.
Rept. No. SAE-750140; 1975; 7p
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 174

REV-74--THE UNIVERSITY OF CINCINNATI ATV WITH INDEPENDENT SUSPENSION

A Recreational Ecological Vehicle (REV) design competition is discussed and the six-wheeled, independently suspended all-terrain vehicle designed by students at the University of Cincinnati for the 1974 competition is described. The vehicle is powered by a two cycle air-cooled engine coupled to twin hydrostatic transmissions by a gear box. Power is provided to the three wheels on each side by chain drives from the hydrostatic transmission on that side of the vehicle. Thrust in the water is provided by a jet pump drive system engaged to the engine. A low center of gravity is maintained by situating the engine, gear-box, hydrostatic units and jet pump as close as possible to the bottom of the vehicle. The general layout provides space for two passengers, both of whom have ample leg room when seated to the rear of the vehicle. The engine, drive train, suspension supports, payload weight, and body are carried by an internal steel frame of welded construction.

by Ivan E. Morse; William R. Shapton
University of Cincinnati
Rept. No. SAE-750143; 1975; 8p
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 175

THE DESIGN OF A 4 WHEEL STEER-4 WHEEL HYDROSTATIC DRIVE ALL-TERRAIN VEHICLE FOR REV-74

The Recreational Ecological Vehicle (REV)-74 was an intercollegiate all terrain vehicle (ATV) design competition organized by the Milwaukee and Cincinnati Sections of the Society of Automotive Engineers (SAE). Competing categories of noise level, destructiveness to terrain and a 25-mile race over land and water were part of the activities involved in the competition. Michigan Tech designed and built a 4 wheel steer-4 wheel hydrostatic drive ATV for REV-74. In the land race competition, the hydraulic and steer systems performed perfectly. The four wheel steering minimized damage to the terrain and gained the vehicle a first place in the non-destructiveness to the terrain category. In water, the vehicle had nine inches of freeboard, allowing for stability, even in rough water. Several production ATV designs and their specifications are reviewed and the final results of REV-74 are tabulated.

by Fredric L. Kinney; Joseph C. Harp; John H. Johnson
Michigan Technological Univ.
Rept. No. SAE-750144; 1975; 12p 5refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975. Partly supported
by the Milwaukee Section of SAE.

HS-018 176

ARIZONA STATE UNIVERSITY'S DESIGN APPROACH TO THE REV 74 COMPETITION

The Milwaukee and Cincinnati divisions of the Society of Automotive Engineers sponsored a 1974 Recreational Ecological Vehicle (REV 74) competition. Students from Arizona State University designed an all terrain vehicle (ATV) with two hydraulic circuits to provide high torque, low-speed performance for steep grades with poor soil conditions, and a series circuit with relatively low torque, high-speed performance for unhindered, cross-country driving. The ecological requirements of the competition involved two major considerations, terrain destruction and noise pollution. One of the positive results of the ATV competition was the experience gained by students who were participating in vehicle design, and in the fields of cost, environmental considerations, and hydraulic system design. The Industrial Design Department at Arizona State University considered the project sufficiently important to adopt it as the basis for a two semester classroom design project. For REV 74, the resulting ATV entry had a six wheel hydrostatic drive, independent suspension, fore and aft combined steering, and a water propulsion system.

by Michael J. Nielsen
Arizona State Univ.
Rept. No. SAE-750145; 1975; 6p
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 177

HYDROSTATIC DRIVE ALL TERRAIN VEHICLE

A hydrostatic transmission system designed and built for a six wheel all terrain vehicle (ATV) is described. The drive train basically consists of a gasoline engine, two pumps, and six hydraulic motors, one for each wheel. The theoretical horsepower required to get the maximum pressure of 3,000 pounds per square inch, and flow of 15 grams per mile per minute capabilities of the two hydraulic systems comprising the transmission is 52.5 horsepower. The vehicle can accommodate one passenger. It weighs 725 pounds (329 kilograms) empty and can achieve a top speed of almost 30 miles per hour (48 kilometers per hour). The instrument panel includes gauges for monitoring the hydraulic line pressures, flowrates and oil temperatures under actual operation conditions. The vehicle was subjected to an intensive testing program that included vehicle climbing capability; control response; water and wetmarsh terrain handling; downhill grade; and highspeed turns. In all cases, the vehicle responded well, with the exception of turning. With equal pressure in all six tires, it was difficult to break the front and rear tires loose, especially if the turn was initiated with the vehicle at rest. This problem was eliminated by putting 8 pounds per square inch (psi) in the center tires and 2 psi in the front and rear tires. Maximum pump pressure that was recorded on the instrument panel was 2500 psi during a 360 degree turn. Typical pump pressures for normal level ground driving were around 700 psi.

by Keith H. Hawks
Purdue Univ., School of Mech. Engrg.
Rept. No. SAE-750146; 1975; 10p
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

NICKEL-ZINC STORAGE BATTERIES AS ENERGY SOURCES FOR ELECTRIC VEHICLES

Factors influencing the transport output of battery driven delivery vans of the 2 to 7 ton class are described. Taking into account the energy densities of batteries, the probability of their practical realization, the development costs and thermal problems, as well as the payload and necessary range of delivery vans in urban applications, a battery with an energy density of 40-60 Wh/kg can serve as an energy source for a practical electric vehicle. Tables show the development stage and development costs of different types of batteries, including a nickel/iron battery and a nickel/zinc battery which falls into the 40-60 Wh/kg category, while remaining in a low-to-medium cost range. Details of the nickel/zinc battery include production cost estimates for using a zinc electrode, where the solubility of the zinc is reduced by adding calcium hydroxide to the electrode material. The nickel oxide electrode is manufactured by developing a nickel powder which can be easily produced and whose shape and surface structure differ considerably from the conventional carbonyl-nickel powder. It is possible to obtain sintered plates by the usual process, which excel by their high porosity and homogeneous pore structure.

by G. Kucera; H. G. Plust; C. Schneider
Deutsche Automobilgesellschaft Forschungslaboratorium (Germany)
Rept. No. SAE-750147; 1975; 11p 23refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

AN OVERVIEW OF THE SODIUM-SULFUR BATTERY

The sodium-sulfur battery is distinguished from other secondary batteries primarily by its use of a solid electrolyte membrane which provides for ion transport and separates the two liquid electrodes, sodium and sulfur. At present, compositions of sodium-lithium-aluminate are routinely fabricated into ceramic electrolyte tubes with a resistivity of about 5 ohm-centimeters at 300 degrees, a strength of greater than 14 kilograms per square inch, and excellent durability in sodium-sodium cells. In the area of powder preparation, the substitution of a relatively inexpensive alumina for Linde C powder has not had a deleterious effect on the final ceramic piece. The search for acceptable materials to contain the sulfur electrode and/or back the porous graphite felt is continuing. Whereas no materials have yet been found which do not corrode, several metal compounds show promise as conductive protective coatings, including: vitreous carbon; aluminum based alloys; and chromium, based on a comparison with vitreous carbon. Cell testing results were encouraging. Sodium-sulfur cells were constructed which operated reproducibly and showed no signs of deterioration after hundreds of cycles. Preliminary results indicated that metallic impurities do not have a severely degrading effect on the conductive ceramic membrane.

by Steven A. Weiner
Ford Motor Co.
Rept. No. SAE-750149; 1975; 10p 5refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, Mich., 24-28 Feb 1975. Supported in part

ADVANCED METHOD FOR REDUCTION IN AXLE GEAR NOISE

The reduction of axle gear noise with the addition of a simple and inexpensive device mounted on either of two side flange of the final drive is demonstrated. The causes of axle gear noise with respect to vibration are considered to be: the bending or torsional resonance vibration of the driveline; and the bending resonance vibration for the transmission of vibration. An inertia disk was devised which makes it possible to decrease the tooth contact force produced on the differential gear or to prevent that force from transmission to the floor panel. Resonance frequencies are adjusted to prevent them from coming close to each other. The frequencies are moved to a desirable frequency range, and the vibration level is reduced by damping. A torsional vibration mode is produced on the driveline with three degrees of freedom. Generally, the torsional vibration of the driveline is analyzed as a mass spring system. The addition of this device, with the resulting additional inertia mass, makes the driveline and its vibration nonsymmetrical with respect to the final drive. This has the effect of decreasing the vibration level of the hypoid gear, as well as changing the resonance frequency of the driveline. A theoretical proof is also given in which the approach is to treat the noise not as associated with the final drive itself, but as a vibration problem in the driveline.

by Eiichi Abe; Hiroshi Hagiwara
Nissan Motor Co., Ltd., Yokosuka, Japan
Rept. No. SAE-750150; 1975; 15p 5refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

WEIGHT REDUCTION OF AUTOMOTIVE PARTS BY USE OF POLYPROPYLENE

Rising costs of fuel and manufacturing prices amplify the importance of finding lightweight, low cost materials which meet strength and flexibility requirements. Specific automotive parts in which polypropylene has been successfully used to reduce weight illustrate how the proper selection of polypropylene based materials was made and the parts designed to meet a range of typical automotive structural requirements. These parts include: battery cases; air conditioner heater housings; head lamp housings; fender extensions; decorative grille/fender liners; fan shrouds; and exterior panels. Based on these successful uses, projections can be made for future polypropylene applications which offer additional potential weight saving opportunities. A technique for assessing the replacement of an existing material with a polypropylene material to reduce weight is presented. This technique compares existing physical properties of both used and proposed materials, and calculates how part weight, cost, thickness, and similar properties are affected. A table is provided which shows the calculated ratios for general property ratios of new and old material; and the calculated ratios for 30 percent glass reinforced chemically coupled polypropylene compared with steel.

by Robert H. Heinold
Hercules Inc.
Rept. No. SAE-750154; 1975; 11p 4refs

HS-018 182

WEIGHT SAVING APPROACHES THROUGH THE USE OF FIBER GLASS-REINFORCED PLASTIC

Problems affecting the availability and cost of fuel have caused automotive engineers to accelerate programs aimed at making ground transportation more energy efficient. Reducing vehicle weight is considered one of the most fundamental ways to achieve this goal. Fiber glass reinforced plastic materials offer a lightweight alternative for components which are or were manufactured from steel. It is estimated that 400 pounds on an automobile generally can be equated with 1 mile per gallon of gasoline. Another estimate proposes that each additional 100 pounds results in a 0.4 mile per gallon decrease for sub-compact and 0.1 miles per gallon decrease on standard cars. One of the most basic ways to reduce car weight is through the substitution of sheet steel with lightweight fiber glass/plastic. Other advantages of such a substitution include: moderate tooling costs which allow for more frequent changes in style and functional design; parts consolidation, whereby subassembly is reduced or eliminated, and warehousing and inventory are simplified; design flexibility; dimensional stability, whereby fiber glass/plastic components perform over a wide range of stress and temperature conditions; and chemical resistance. Applications in the 1975 model year included 27 automobile models with front end panels of fiber glass-reinforced plastic.

by Eldon D. Trueman
Owens-Corning Fiberglass Corp., Transportation Materials Div.
Rept. No. SAE-750155 ; 1975 ; 6p 6refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 183

THERMOPLASTICS PRODUCE SIGNIFICANT WEIGHT REDUCTION IN AUTOMOTIVE APPLICATIONS

Weight reduction on the automobile has become a critical design priority in the automotive industry today. In addition to this, the industry is faced with increased consumer demands for fuel economy, and governmental demands for emission control systems. Designers must look for materials which have strong performance characteristics and low specific gravities for lighter weight. Several thermoplastic resins are considered in terms of their tough properties and economic applications. NORYL, is a phenylene oxide based resin which offers structural strength at elevated temperatures; impact resistance at minus 40° F, and dimensional stability in humidity. Parts molded in NORYL resin may be chrome plated for high-appearance parts. VALOX, a polybutylene terephthalate thermoplastic polyester resin has property features that give this engineering thermoplastic a significant advantage over other materials, including high heat resistance of over 350° F, and is a good choice for exterior body panels, fender extensions, head lamp housings, and window louvers. LEXAN, a polycarbonate thermoplastic resin is a virtually unbreakable material, in addition to having a high optical clarity for application in automo-

bile lenses. Uses of these products in the Pontiac Grand Am, AMC Matador Coupe, Cadillac, and Chevelle are described.

by William J. Windscheif
General Electric Plastics
Rept. No. SAE-750157 ; 1975 ; 11p
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 184

ESTIMATION OF CONTRIBUTED NOISE LEVELS OF DIESEL ENGINE COMPONENTS FROM VIBRATION MEASUREMENTS

An experimental technique for estimating the contributed noise levels of diesel engine components is presented. The technique predicts the contributed noise level in a reverberant acoustic environment from vibration measurements made on the surfaces of the engine components and the use of simple acoustic radiation theory. An experimentally determined value of the radiation efficiency is used in calculating the contributed noise levels. This value, determined for a high speed Vee form engine, measures the mean square surface velocity of each engine component, and along with a knowledge of the radiation efficiency and the component surface area, estimates the noise level. Although no rigorous error analysis has been done, accuracy is probably within 1-2 decibels, providing enough measurements are taken to ensure that a statistically reliable value of space-time mean-squared velocity of the surface is used in the calculation. This method is attractive because it involves less experimental time, less material cost, and is easier to conduct than other experimental techniques.

by Andrew F. Seybert
Purdue Univ., School of Mech. Engrg.
Rept. No. SAE-750160 ; 1975 ; 8p 10refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 185

DESIGN OF ELECTRONICS FOR THE AUTOMOTIVE ENVIRONMENT

The designer of electronic equipment for use in automobiles must design much of the equipment for reliable operation within the engine compartment, while at the same time maintaining a low cost approach, considering the service facilities available, considering automotive environment conditions, and meeting the specifications of these conditions by the automotive engineer. The general pattern of design procedures will particularly stress the environmental testing and fault analysis. A combination of design experience and failure analysis feedback allows components to be used reliably up to operating limits. Because components are being operated near their limits, a small increase in the specified operating temperature may necessitate a change to more expensive components, and for this reason automobile manufacturers should not allow themselves safety factors on the temperature rating of the equipment. It is much easier to design electronic equipment for operation in passenger and luggage compartment environments, and substantial cost savings can be made by allowing

electronics to be mounted there in preference to under the hood.

by L. Phoenix
Lucas Electrical Co., Ltd. (England)
Rept. No. SAE-750162 ; 1975 ; 12p 8refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 186

HOW THEY'RE USING ON-BOARD CRASH RECORDERS TO PROBE PUZZLING QUESTIONS ABOUT CAR SAFETY

About 1500 disk-type crash recorders are now in use in government and commercial fleet vehicles under the terms of a no-cost agreement with the National Highway Traffic Safety Administration. The recorders note sudden changes in velocity in three directions during an accident: forward/backward; lateral; and vertical. Each measurement is made by means of a magnetically damped accelerometer, consisting of a copper coil suspended in a magnetic field. An aluminum stylus is attached to the copper coil and is capable of signaling sudden movements through the magnetic field. These movements are recorded on a small disk of iron oxide/polypropylene material. So far, the recorders have provided reliable, objective data, making it possible to accurately state precise speeds at the time of impact, a valuable tool in evaluating the usefulness of safety belts and air bag equipment. Crash recorders have been involved in more than 50 accidents severe enough to warrant comprehensive investigations. In addition, the disk recorder can provide data useful in improving the structure of automobiles.

by William Hoffer
Publ: Popular Science v207 n4 p94-5, 154 (Oct 1975)
1975
Availability: See publication

HS-018 187

1976 LICENSE PLATE DISPLAY REQUIREMENTS

The 1976 license plates display requirements for all 50 states and the District of Columbia are given. Statistics include: physical properties of the plates such as color, reflectorized or non-reflectorized, and type of metal used; size of plate; bolt holes spacing; plate position in relation to rear lamp; where license plate is displayed; and general state requirements for the fastening and display of plates.

Motor Vehicle Manufacturers Assoc. of the United States, Inc.
1975 ; 61p
Availability: Corporate author

HS-018 188

ROAD USER BEHAVIOUR AND TRAFFIC SAFETY: TOWARD A RATIONAL STRATEGY OF ACCIDENT PREVENTION

The question of road user behavior in the role of traffic safety is presented with the case of a 34 year old woman who ex-

which was legally her fault. The woman demonstrated a low tolerance for risk, while at the same time demonstrating correct driving practices as far as speed limits and obedience to traffic signals. This poses an interesting traffic educational paradox: behavior in a common manner so that a driver's actions become more predictable to other road users versus road safety advantages if the average road user were characterized by a low tolerance for risk. Publications in the area of road user psychology show a large number of extremely diversified theories, each focusing on a different cause for traffic accidents. However, most theories are related to either the transient state of the organism, such as fatigue, alcohol, drug, or permanent state of the organism, including driver experience, sex, age, and personality. Two more categories: mental load and risk taking behavior, as well as social influence and social imitation, make up the bulk of the remaining theories. The crucial role played by the tolerance for risk in the causation of accidents is explained through an attempt to integrate these existing theories of driver behavior in a comprehensive model. The model views the causation of accidents as a homeostatically controlled process. According to the model, a driver perceives at any moment of his trip, a certain amount of risk, which he compares with the amount of risk that he is prepared to accept. To the extent that the amount of perceived risk is greater than the amount of risk tolerated, he will try to apply a greater amount of caution. Therefore, the real amount of caution depends upon the driver's ability to make the correct decisions and to execute them in an adequate manner. Design of such a system, however, is not an easy matter, due to the fact that as drivers become aware of the reduction in the number of accidents after some time, the amount of generally perceived risk likewise diminishes. Frequency of accidents, therefore, will increase until the equilibrium is re-established.

by G. J. S. Wilde
Queens Univ., Studies of Safety in Transport, Kingston, Ont.
K7L 3N6 Canada
1975 ; 42p 32refs
French summary. Partially supported by the Ministry of Transport, Rd. and Motor Vehicle Traffic Safety, Ottawa, Canada. Presented at the Annual Convention of the Dutch Road Safety League, Amsterdam, 26 Apr 1975.
Availability: Corporate author

FUEL CONSUMPTION OF TRACTOR-TRAILER TRUCKS AS AFFECTED BY SPEED LIMIT AND PAYLOAD WEIGHT. FINAL REPORT

The effect of speed limit and payload weight on fuel consumption was determined in tests of tractor-trailer rigs. Two virtually identical vehicles were used, one loaded with a 28,000 pound payload and the other carrying 42,000 pounds. Each was driven over two different sets of terrain on the Massachusetts Turnpike at simulated speed limits of 50, 55 and 60 mph. Onboard Transportation Systems Center personnel recorded data on tank-measured fuel consumption, trip average speed, and other vehicle parameters. An analysis of the data led to the following conclusions: increased fuel consumption results from higher speed limits in the range of 50 to 60 mph; terrain is an important factor in determining the effect of speed limit on fuel consumption; and a payload increase from 28,000 pounds to 42,000 pounds is carried at no detectable increase in fuel consumption for the "hilly" route, and less than a 7 percent increase in fuel consumption for the route in-

thirteenth gear test data; median temperature test data; average speed test data; analysis of variance summary; simple main effects for vehicles and speed on different routes; and Newman-Keuls test results for speed.

by Anthony J. Broderick
Department of Transportation, Transportation Systems Center,
Kendall Square, Cambridge, Mass. 02142
Rept. No. DOT-TSC-OST-75-3 ; 1975 ; 34p
Report for Dec 1973-Jul 1974.
Availability: NTIS

HS-018 190

VEHICLE-PAVEMENT INTERACTION STUDY. FINAL REPORT

The final report on vehicle-pavement interaction research, describing methods, procedures and results of a study begun in September 1969 is presented. Investigations were made in the laboratory on selected pavement surfaces including: belt finished concrete; clay-filled tar; crushed limestone; hot mix asphalt; chip seal gravel surface; and a lightweight asphalt-concrete aggregate. Measurements were made on pavement surfaces on Texas highways and on control surfaces constructed at the Texas A&M Research annex. The effect of rainfall was examined and an equation was developed to relate water depth to the friction properties of various pavement types. Expressions were also developed relating pavement characteristics to vehicle speed, and tire tread depth to skid or friction number. Skid trailer friction data for combined surfaces were analyzed using a computerized multiple-regression system to obtain the best fit of the data.

by R. M. Olson; J. H. Johnson; B. M. Galloway
Texas A and M Univ., Texas Transportation Inst., College
Station, Tex. 77843
Rept. No. RR-138-7F; TTI-2-8-69-138-7F ; 1974 ; 73p 12refs
Sponsored by the Texas Hwy. Dept. in cooperation with the
Federal Hwy. Administration. Report for Sep 1968-Oct 1974.
Availability: Corporate author

HS-018 191

AN EXPERIMENTAL STUDY OF DRIVER AND PEDESTRIAN INTERACTION DURING THE CROSSING CONFLICT

A controlled experiment was conducted to determine the relative importance of pedestrian, vehicle, and situational factors in influencing drivers to yield to crossing pedestrians. The following variables were combined in a complete factorial design: type of crossing; distance between oncoming vehicle and pedestrian; orientation of pedestrian; number of pedestrians; and approach velocity of vehicle. Trained pedestrians (three males) performed the start of an ordinary street crossing attempt and interacted with regular drivers whose response was measured in terms of changes in vehicle velocity. The experiment was replicated at two sites for a total of 960 crossing trials. The results show that drivers slowed down, or stopped more, for crossing pedestrians when: the approach speed of the vehicle was low; the crossing took place on a marked crosswalk; there was a relatively long distance between the vehicle and the pedestrian's point of entry into the road; a group of pedestrians, rather than an individual, attempted to

down more than other drivers.

by A. Katz; D. Zaidel; A. Elgrishi
Publ: Human Factors v17 n5 p514-27 (Oct 1975)
1975 ; 21refs
Availability: See publication

HS-018 192

HOW TO OBTAIN THE RIGHT OF WAY: AN EXPERIMENTAL ANALYSIS OF BEHAVIOR AT INTERSECTIONS

Conflicts of interest over who shall assume the right of way at unmarked intersections may be viewed as a subset of a more general class of conflicts whose resolution is shaped by various strategies of deterrence. In order to examine the effects of five variables upon the determination of right of way, a simulated driving situation was developed in the laboratory, involving the presentation of a series of slide photographs of two vehicles, A and B, approaching an unmarked intersection. Male (24) and female (24) subjects (S) were asked to act either as the driver of one of the two vehicles (A) or as the observer of both vehicles. In addition, the size of the second vehicle (B), the sex of its driver, as well as driver B's maintenance or avoidance of eye contact with A were varied. Ss predicted, with greater confidence, that vehicle B would cross the intersection first (that driver A would be deterred from seizing the right of way) when B was the same size as A, rather than a vehicle either larger or smaller; when driver B was female, rather than male; and when driver B avoided, rather than maintained eye contact with A. In addition to these three main differences, a number of interactions emerged between the eye contact variable and one or more of the other four. Several of these findings were interpreted as lending support to a previous researcher's description of the strategic efficacy of "binding oneself" to a course of action.

by Jeffrey Z. Rubin; Bruce D. Steinberg; John R. Gerrein
Publ: Perceptual and Motor Skills v39 n3 p1263-74 (Dec 1974)
1974 ; 19refs
Availability: See publication

HS-018 193

THE EPIDEMIOLOGY OF POLE CRASHES

Data from traffic accident information forms completed by police officers were used to study the epidemiology of collisions between motor vehicles and poles in New South Wales, Australia. More than half of these crashes in 1973 involved casualties. Collisions with poles were about three times as serious as the average crash in terms of fatalities and account for about one in sixteen traffic crash fatalities. In New South Wales during 1973 there were 2,557 crashes reported involving single vehicles colliding with poles (2.1% of all reported traffic crashes). These crashes accounted for 6.4% of all fatal crashes and 4.6% of all non-fatal casualty crashes. Collisions with poles constituted the largest single category of vehicle-object crashes and more than half involved casualties. The cost of pole crashes in New South Wales was estimated to be about eight million dollars, or about nine dollars for each roadside pole in the state. These crashes occurred disproportionately in the late night-early morning period, on weekends, in fine dry weather, and on straight or curved road segments. Alcohol ap-

pears to have played a strong causal role in the occurrence of pole crashes, being present in about one in six crashes, and in the blood of two-thirds of pole crash fatalities. It is suggested that existing technology is such that poles could be modified, removed, or replaced to provide greater impact protection. Since collisions with objects other than poles—except trees—were less dangerous, the removal of poles is not likely to simply transfer casualties from one crash type to another. It is recommended that a pilot program of pole modification be initiated in order to evaluate the cost-effectiveness of such modifications. Accident, injury, and fatality statistics resulting from pole collisions in the years 1964-1974 are tabulated. In addition, 1973 statistics are tabulated for vehicle-fixed object crashes, pole collisions by time of day and day of week classified as fatal or non-fatal, numbers of pole collision fatalities and non-fatal casualties, pole crashes by month, class of road user, age and sex of fatalities, speed limit, vehicle type, weather conditions, highway characteristics, road conditions, sobriety, driver license status, seat belt usage, blood alcohol levels, type of pole and pole damage, and data from electricity supply authorities.

by Rodney G. Vaughan
Department of Motor Transport, Traffic Accident Res. Unit,
Box 28, G.P.O., Sydney, 2001 Australia
Rept. No. 3/75 : 1975 ; 115p 26refs
Availability: Corporate author

HS-018 194

FACTORS CONTRIBUTING TO THE REDUCTION OF MOTOR VEHICLE TRAFFIC FATALITIES (JANUARY-APRIL 1974 VS JANUARY-APRIL 1973)

The sharp decline in motor vehicle fatalities which occurred in the first four months of 1974 was investigated. Traffic accident fatalities declined by 24% as compared to the same period in 1973. Preliminary analysis of the reduction of fatalities indicates that the following factors contributed to this decline: reduction in speed, resulting from the institution of the speed limit; reduction in the availability of gasoline, and therefore of travel; reduction in average occupancy; changes in day and night travel patterns; change in the type of road used; and increased use of safety belts. Estimates based on the distribution of speeds preceding fatal accidents together with speed trend studies, injury-to-death ratios, and other supporting evidence indicate that the imposition of the 55 mph speed limit accounts for about 11% of the decrease from the 1973 total fatalities (that is, almost half of the total decline). While driver deaths decreased by 23%, passenger deaths declined by 33%, indicating a decline in the average occupancy of vehicles. There appears to have been a larger decrease in nighttime travel than in daytime travel.

National Safety Council, Statistics Div., Chicago, Ill. 60611
1974 ; 16p 10refs
Availability: Corporate author

HS-018 195

FACTORS CONTRIBUTING TO THE REDUCTION OF MOTOR VEHICLE TRAFFIC FATALITIES (MAY- AUGUST 1974 VS MAY-AUGUST 1973)

During the four month period May through August 1974 the

for 1973. Speed reduction appears to have been the largest single contributing factor, accounting for over half of the fatality reduction (10% out of the 17% total). The effect of speed reduction on traffic fatalities was analyzed using data on the accident rate and mileage on rural roadways, estimating the expected number of fatalities based on changes in total rural mileage, and comparing this estimate with actual fatalities. Three other factors were estimated to have contributed 2% each to the total reduction: changes in the amount and circumstances of travel, reduced average occupancy of passenger cars, and increased use of safety belts in 1974 model automobiles. Night travel appears to have decreased, as has the proportion of driving done at night. Passenger fatalities decreased 21% during this period, while driver fatalities decreased only 15%, indicating a decline in the average occupancy of automobiles. The seat belt interlock system used on 1974 model cars doubled the use of restraints on these models compared to older ones. While comparisons between the first four months of 1973 and 1974 showed a 24% reduction in fatalities for the latter year, less than half of the total reduction was attributable to lower speeds. During the May through August period, low speeds appear to be responsible for more than half of the total decrease. The first four months of 1974 showed a 6.2% decrease in mileage from the corresponding 1973 period and the second four months showed only a 1.8% decrease. The effect of the average occupancy of passenger cars also decreased from the first four month period to the second. Traffic effects of the seat belt interlock system increased due to the increased number of 1974 model cars in use on the highway.

National Safety Council, Statistics Div., Chicago, Ill. 60611
1975 ; 17p 9refs
Availability: Corporate author

HS-018 196

ALCOHOL AND DRIVING: A SURVEY OF PROSECUTION AND DEFENSE ALCOHOL ESTIMATIONS

The results from a laboratory dealing with defense samples of blood and urine taken for the purposes of the former British Road Traffic and Safety Acts and for the present Road Traffic Act (1972) were compared with the results from a laboratory dealing with such samples for the prosecution. Although both laboratories have samples in common, they are not duplicate surveys. The samples of blood and urine were analyzed for ethyl alcohol using a technique involving a mechanical dilution of the blood with a solution of n-propanol in water followed by gas chromatography and instrumental peak area estimation. A statistical examination of the results of the surveys of random samples of male defense and prosecution samples showed the mean values to be significantly different. The fact that defense samples are analyzed only if the defendant wishes (and only about 11% so choose) accounts for this difference in results. An examination of the much smaller number of samples of female blood shows that for defense samples there is no statistically significant difference between male and female blood alcohol levels, but for prosecution samples the difference is significant. Only 1 to 2% of tested drivers were female, while women account for about 25% of all drivers. Although the alcohol content of prosecution and defense samples has fallen by about 25% since the enactment of the Road Safety Act, it is suggested that this lower figure is merely the result of gathering samples from drivers with lower alcohol

roduction of breath tests and permissible levels of alcohol has had no continuing effect on the reduction of the average alcohol levels in drinking drivers. The apparent failure rate of the breathalyzer, in terms of numbers of people below the statutory limit taken for blood sampling, is slightly lower than expected. The sampling and packing techniques have been shown to be effective, there being only a trivial failure rate and interference rate.

by J. S. Oliver; E. Sloan; Hamilton Smith; W. J. Rodger
 Publ: Medicine, Science and the Law, v15 n3 p211-7 (Jul 1975)
 1975 ; 4refs
 Availability: See publication

HS-018 197

DRINKING-DRIVING AND FATAL CRASHES: A NEW PERSPECTIVE

A discussion of the role of alcohol in fatal traffic accidents is presented. Although it is widely believed that 50% or more of the total traffic deaths are related to alcohol and that the problem drinker is responsible for about 33% of all traffic deaths, there is no objective research to support these beliefs. It is suggested that as more sophisticated and objective information becomes available that proportion of fatal crashes involving alcohol in some causal manner will be found to be on the order of 25 to 35%. If a 30% figure is accurate, there must be other major factors causing traffic fatalities which are currently being ignored. Differences between drunken driving, involving a blood alcohol concentration (BAC) of 0.10% or more, and driving with lower BAC levels must be recognized. Although available information shows that about 90% of drunken drivers and 80% of drivers with a positive BAC below 0.10% are responsible for their own crashes, more than 70% of sober drivers are also responsible for their own crashes resulting in death. Fatal accidents should be considered as being quite different from collisions in general, and they probably require different countermeasures. In addition, BACs below 0.05% are not related to collisions in general, and the level at which alcohol becomes a significant factor in fatal crashes is probably at 0.10% or higher. Research indicates that it is not alcohol, per se, which leads to serious or fatal crashes, but alcohol in combination with other characteristics that make them high-risk drivers. Available literature indicates that at least 80% of all drinking drivers in fatal crashes have BACs of 0.10% or higher and that more than half of all drinking drivers in fatal crashes have BACs of at least 0.15%. Using these figures to determine the percentage of fatal accidents in which alcohol plays a causal role shows that only about 30% of traffic deaths can be attributed to alcohol.

by Richard Zylman
 Publ: Journal of Alcohol and Drug Education v21 n1 p1-10 (Fall 1975)
 1975

Presented to the San Diego Summer School of Alcohol Studies, University of California at LaJolla, 26-30 Aug 1974.
 Availability: See publication

HS-018 198

SEAT BELTS: CHANGING USAGE BY CHANGING BELIEFS

A model to predict seat belt use, based on a linear combination of beliefs about discomfort when wearing seat belts and

beliefs about injury-reducing effects of seat belts, was tested. A group of 154 employees of a large steel company, all non-users of seat belts, were randomly assigned to one of six groups receiving one or a combination of the following treatments: verbal information stressing the role of seat belts in reducing injury; nonverbal practice in seat belt use; verbal information irrelevant to seat belt use; or no treatment. Beliefs were measured by responses to questions about discomfort and effect variables. Seat belt usage was measured by direct observation at the steel plant's parking lot. Groups receiving seat belt information had the most favorable post-test beliefs and displayed the greatest increase in seat belt usage, although the effects generally decreased over time. It is concluded that the weighted sum of the discomfort and the effect factors can be viewed as a determinant of the disposition for seat belt use. Actual usage for a given individual in a particular situation would then depend on his/her value of seat belt disposition, resulting from his/her beliefs, in relation to the situational difficulty. The information provided in these experiments made some subjects attain the level of disposition plus effect necessary to exceed the threshold posed by the situation. While the discomfort factor and the discomfort plus effect model were found to be equally predictive, the effect factor was predictive only at low values. It is suggested that a multiplicative model for combining discomfort and effect would be superior to the proposed linear model.

by Gunilla Phaner; Monica Hane
 Publ: Journal of Applied Psychology v60 n5 p589-98 (1975)
 1975 ; 11refs
 See HS-015 623 for earlier report.
 Availability: See publication.

HS-018 199

TRAINING A PATIENT TO DRIVE WITH TELESCOPIC LENSES

An interdisciplinary approach to licensing partially-sighted individuals to drive is discussed. The first step in such an approach is a thorough optometric evaluation to determine the level of correction possible with telescopic lenses and the capability of obtaining full field vision. Following such optometric evaluation, the individual should be interviewed by a special education instructor in order to determine the individual's potential for driving abilities and motivations. Screening tests can be administered to determine knowledge of traffic safety and recognition of and reaction to road conditions. Road performance tests can also be administered by the special education instructor. A clip-on bioptic device loaned to the individual can be used to help him learn to spot road hazards, signs, and other objects relevant to driving while a passenger in a car, providing an early simulation of the driving experience. The special education instructor can then train the individual, using a dual-control vehicle. The special education instructor should then administer an extensive road test in the individual's own car to evaluate driving performance. The road test administered by the driver licensing agency should be supervised by a person familiar with telescopic spectacles and should provide an extensive evaluation of the individual's ability to handle a car under every imaginable road condition. A conference among the optometrist, special education instructor, and official from the licensing agency should then be held to decide upon any special restrictions to be placed on the license. No night driving is probably the most common restriction to date. The case of one partially-sighted patient is related to illustrate how this program can work. This three-

way program assures that only safe, reliable, and competent drivers will be licensed to drive, while providing driving opportunities for those partially-sighted individuals who can qualify for and pass this extensive training program for driving with telescopic lenses.

by Randall T. Jose; James H. Butler
 Publ: American Journal of Optometry and Physiological Optics
 v52 n5 p343-6 (May 1975)
 1975 ; 3refs
 Availability: See publication

HS-018 200

THE EFFECTS OF MANDATORY SEAT BELT WEARING ON THE MORTALITY AND PATTERN OF INJURY OF CAR OCCUPANTS INVOLVED IN MOTOR VEHICLE CRASHES IN VICTORIA

In order to assess the effect of seat belt wearing on the number and severity of injuries received in motor vehicle accidents, a series of motor vehicle crash patients admitted to Preston and Northcote Community Hospital, in Victoria, Australia, were analyzed during the period July 1970 to December 1973. Following the introduction of compulsory seat belt wearing legislation in 1970, adult car occupant deaths fell by between 15 and 20% during the first 12 months and has remained at this lower level since. The hospital survey demonstrated significant variations of major injury patterns, not only for the broad groups of road users, but also in relation to the nature of the collision and, in the case of car occupants, the use of or non-use of a restraint. Although there has been a slight increase in the number of patients attending the hospital for treatment following motor vehicle accidents, there has been a significant decrease in the number of patients admitted since the passage of the legislation. There has been an effective reduction in the number of deaths and serious injuries of adult car occupants involved in crashes, but the death rate for children under the age of 8 years has remained unchanged. Only about 5.5% of children in this age group are restrained while travelling in motor vehicles. In frontal impacts, there has been a remarkable reduction in the severity of injury, particularly with regard to severe facial lacerations, major eye injuries, multiple fractures of the face, and severe head injuries. However, with side impacts the occupant is still relatively unprotected and the number of severe injuries remains high and relatively uninfluenced by the wearing of seat belts, apart from a real reduction in the number of major head injuries. It is recommended that the present design of lap-sash seat belts be improved through the addition of features designed to reduce the incidence of injuries caused by lap-sash seat belts themselves in frontal impacts and to better protect the occupant in side impact and overturning crashes. About 10% of car occupants admitted to the hospital after frontal impact accidents showed injuries directly attributable to the wearing of seat belts, although the seat belt probably prevented other, more serious injury.

by G. W. Trinca; B. J. Dooley
 Publ: Medical Journal of Australia v1 p675-8 (31 May 1975)
 1975

Availability: See publication; B. J. Dooley, 141 Grey St., East Melbourne, Vic. 3002 Australia

HS-018 201

MOTORCYCLE TRAUMA

A retrospective study was conducted on 324 patients hospitalized at the Naval Regional Medical Center in Oakland, California, as a result of motorcycle trauma during the period July 1971 through July 1973. Of the 324 injured, 304 were drivers and 20 were passengers. Of the total injured, 141 required no major surgery, 127 required only one procedure, 52 required two to five operations, and four required six or more procedures. Ten of the patients died. There were 240 major fractures, and multiple fractures were common. Amputations were required for 15 patients. Abdominal and thoracic injuries were relatively uncommon. Central nervous system injuries were frequent, with 83 patients experiencing at least transient unconsciousness. Forty-two had some permanent residual disability. Efforts to decrease the number and severity of motorcycle injuries should include: education of the public regarding the hazards of motorcycling; encouraging the wearing of protective equipment by cyclists; the establishment of motorcycle driver education classes at schools; and the requirement of specific licensing of all motorcycle drivers by each state.

by R. M. Deaner; V. H. Fitchett
 Publ: Medical Journal of Trauma v15 n8 p678-81 (Aug 1975)
 1975 ; 5refs
 Supported by the Navy Dept., Bureau of Medicine and Surgery.
 Availability: See publication; Publications Office, Clinical Investigation Center, Naval Regional Medical Center, Oakland, Calif. 94627

HS-018 202

EMERGENCY MEDICAL TECHNICIAN (EMT-A) TRAINING IN A MEDICAL SCHOOL ENVIRONMENT

All persons who transport sick or injured people in Connecticut are required to have 81 hours of emergency medical training for emergency medical technicians (EMT) beyond a standard 40 hour first-aid course. The University of Connecticut Health Center in Farmington offers EMT courses for ambulance personnel in the Hartford region. Teachers in the program include medical faculty, emergency room nurses, and Health Center rescue team members. Other specialists may lecture on topics in their particular fields. In addition to written tests, practical examinations involving simulated emergencies are administered. These practical situational exams involve both team and individual efforts and performance. Practical teaching is achieved using videotape equipment and small group analysis of performance. Students approach the problems as realistic challenges. Broad ranges of educational and linguistic backgrounds can be easily accommodated in the program. Untoward facial expressions and talk, lack of organization, and lack of communication between team members and simulated victims rapidly disappear. The course includes a three hour session weekly for 22 weeks, plus work time with the videotape. High levels of teaching and performance training success have been achieved and good relations have

developed between the university health center and the community services served by the program.

by George M. Watkins; Gregory N. Metcalf; Louis G. Audette
Publ: Journal of Trauma v15 n9 p772-8 (Sep 1975)
1975 ; 5refs
Presented at the Annual Session of the American Assoc. for
the Surgery of Trauma, (34th), Hot Springs, Va., 17-19 Oct
1974.
Availability: See publication; George M. Watkins, University
of Connecticut Health Center, Farmington, Conn. 06032

HS-018 203

SNOWMOBILES. STILL ON THIN ICE

The machine and driver factors that continue to contribute to hazards in snowmobile use are discussed. In 1973, 19,000 people were sent to hospital emergency rooms for injuries received while riding in a snowmobile, and during the 1974-75 season, there were 170 snowmobile fatalities. Several snowmobile accidents are examined, and the contributing causes and their possible prevention are discussed. Major factors are: too high a center of gravity and poor suspension system on the vehicle, lack of driver education, and scarcity of safe trails. The following recommendations are made to snowmobile owners: purchase industry-certified models only; don't buy more machine than you need; learn to ride before you take your snowmobile out on the trail; find out where the safe trails are and use only those; dress properly; wear earplugs to protect your ears from excessive noise; protect your back by learning to post over rough terrain; never travel long distances by yourself; carry emergency equipment along with you; and leave alcoholic beverages at home.

by Gurney Williams, 3rd.
Publ: Family Health v8 n1 p32-4, 66, 68 (Jan 1976)
1976
Availability: See publication

HS-018 204

AN EVALUATION OF THE EFFECTS OF TREAD DEPTH, PAVEMENT TEXTURE, AND WATER FILM THICKNESS ON SKID NUMBER-SPEED GRADIENTS

A total of 31 sites representing the types of pavement surfaces on the highways of Virginia were tested with a skid trailer at 30, 40, 50, 60, and 70 mph in an effort to determine the influence that tire tread depth, pavement texture, and water film thickness have on the deterioration of skid numbers with increasing test speeds; and develop curves which will provide a means of predicting skid numbers for given combinations of these factors other than those employed during testing. The tests employed six tire conditions (tread depths from new to bald) and four water conditions (depths of .020, .015, .030, and .040 inch). It is concluded that: high skid number-speed gradients are common to pavements that do not contain a relatively high degree of macrotexture; the slope of the skid number-speed gradient curve decreases with increased macrotexture; pavements that have essentially the same skid number-speed gradients can have quite different relationships between treaded and bald tires; a low macrotexture-high microtexture surface provides the best skid resistance at low speeds; grooving does not greatly influence the skid resistance or the skid number-speed gradient slope for treaded tires, but does manifestly increase the skid resistance for bald tires; the

skid number-speed gradient curves developed in this study can be used for speeds other than the ones tested; the skid number decreases as the test tire tread decreases; after a tire has worn beyond 3/32 inch tread depth, it has a high reaction to pavement macrotexture and should not be used for routine testing; and because of the small change in skid number with a change in water film, a normal fluctuation in water output by the test trailer should not be a matter of concern.

by David C. Mahone
Virginia Hwy. and Transportation Res. Council, Box 3817
University Station, Charlottesville, Va. 22903
Rept. No. VHTRC-75-R40 ; 1975 ; 200p 7refs
Prepared in cooperation with the Federal Hwy.
Administration.
Availability: Corporate author

HS-018 205

VEHICLE NOISE ENFORCEMENT

On January 1, 1968, California entered the field of enforcing motor vehicle noise limits by the use of sound level meters. The current vehicle noise measurement operations, conducted on a smooth paved surface with a microphone located 50 feet from the centerline of travel of the vehicle, are described, and a brief history of the attempts by the state to use sound level meters for noise enforcement is provided. The program met with several problems; chief among them was the lack of readily available highway measurement sites and the differences in city and highway noise levels. California's noise enforcement system is practical, although problems still remain. Motorcycle manufacturers are warning dealers and customers not to modify the vehicles to produce noise. Advertisements for loud mufflers in magazines have shown a substantial drop. The legislature and different departments of the state are moving in directions to further improve the effectiveness of the program and to bring about quieter vehicles on streets and highways.

by Warren M. Heath
Publ: Water, Air, and Soil Pollution v4 n3/4 p329-42 (Jul/Aug 1975)
1975 ; 10refs
Availability: See publication

HS-018 206

BICYCLE-MOTOR VEHICLE ACCIDENT TRENDS IN THE CITY OF MILWAUKEE. 1971-1973

An increase in both bicycle usage, and bicycle-vehicle accidents reported in Milwaukee in the three-year period from 1971-1973, led to an analysis of accident report studies to determine trends in accidents of this type during that time period. Tabulations were taken on bicycle accidents by: month; time of day; light conditions; age of the bicyclist; type of failure of the bicyclist; type of failure of the vehicle driver; type of road conditions; and type of injury to the bicyclist. It was concluded that: more adults are using bicycles; bicycles are being used more often in evening hours than previously; usage has extended into the late fall, early spring and winter months; ridership increased during other than perfect weather;

requirements to obey traffic control devices.

by Elton G. Diehl
Bureau of Traffic Engineering and Electrical Services, Res.
and Planning Section, Milwaukee, Wis.
1975 ; 12p
Availability: Corporate author

HS-018 207

AN EVALUATION OF STATE TRAFFIC SAFETY INFORMATION AND EDUCATION PROGRAMS

A total of 71 separate state agencies producing traffic safety information and educational material and representing 46 states and the District of Columbia are included in this study of state traffic safety information and education programs. Most of the traffic safety information and education officials represented in this study see their job as being a part of an overall traffic safety program which may also include enforcement activities, improving of highways, improving emergency medical services, the actions of the judiciary, striving for safer vehicles, and better licensing procedures. Within the area of information and education, the majority of officials feel it is their job to increase public awareness of the traffic accident problem. In summarizing specific points, the study shows that: there is sometimes a duplication of effort within many states in the field of information and education; efforts are sometimes unorganized and superficial; and often informational campaigns are not coordinated with any other traffic safety countermeasure. Daily and weekly newspapers are still the most widely used media in conveying traffic safety information, with radio and television growing in usage. Use of outdoor advertising is decreasing due to state and Federal pressure limiting outdoor advertising. More than half of the agencies replying to the survey produce an employee or public traffic safety publication on a regular basis, and most were involved in some type of educational activity within schools, civic and social groups. Responding officials felt that the press and radio were most successful in building traffic safety awareness among the public. The majority of work is directed at the problem of drinking and driving, with educating the public as to traffic legislation second and the problem of speeding third. Nearly twice as many of the officials polled felt that traffic safety information and education aimed at specific problems was more successful than more general campaigns and had some type of response to indicate success in that particular area.

by Clark Germann
Wyoming Hwy. Patrol, P. O. Box 1708, Cheyenne, Wyo. 82001
1974 ; 37p 4refs
Availability: Corporate author

HS-018 208

CHARACTERISTICS OF VEHICLES OWNED BY "DRUNKEN DRIVERS" IN NEW YORK STATE

A survey was made of the characteristics of automobiles owned by drunken drivers in New York State. Data was produced using the data retrieval system developed under the Vehicle Safety Design Surveillance System (VSDSS) which contains information related to vehicles, drivers and accidents. Drivers were from two groups: those with a conviction for "driving while ability impaired by alcohol"; and those without

1971); and vehicles involved in accidents by model year, weight, horsepower, and county. The data demonstrated that vehicles owned by persons with drinking convictions differed from those owned by persons without such convictions by make, year, weight, and horsepower. Drivers with drinking convictions were found to own a greater proportion of domestic cars and cars of the 1965-1967 model years, heavier vehicles, and vehicles of 175 horsepower or more. A subsequent report, using the data bank used in this study, showed that occupants of heavier vehicles were less likely to experience serious injury than occupants of lighter vehicles. Reasons for differences in the type of car owned by the two groups is not inferable from the data, but it is suggested that persons with drinking problems possess socio-economic characteristics which lend themselves toward owning vehicles of a certain type.

by Charles W. Bostick; D. Barry Negri
New York State Dept. of Motor Vehicles
Rept. No. RR-1973-10 ; 1973 ; 17p
Availability: Corporate author

HS-018 210

AN ANALYSIS OF THE RELATIONSHIPS BETWEEN THE RENEWAL RULES TESTS AND THE ACCIDENT AND VIOLATION HISTORIES

Data were collected from all renewal driver licensing applicants who presented themselves during a one-week period January, 1973, in North Carolina, about 12,000 applicants in all. Data available for analysis included: driver history records of accidents and violations of the four preceding years; information on age, sex, race, level of education, amount of driving, and age of the car of the driving applicant; and the renewal tests, which were being analyzed to test the relationship between the renewal test and accident and violation histories. Each of the new tests consisted of 25 multiple choice items. In general, the results obtained on the new tests were more positive than the tests they replaced. However, in the current form, the new renewal tests possess limited capability for predicting accidents and/or violations, so their application as screening tests is limited. The new renewal tests possess a unifactor structure. A more comprehensive driver licensing evaluation system should contain: a measure of current driving rules to insure that the applicant is up-to-date in law and rules of the road; a measure of the applicant's knowledge of car handling techniques under emergency situations; a measure designed to increment the accident-violation predictive capability of the system; and an experimental set of test items to increase the understanding of the relationships important in preventing accidents and violations.

by F. Reid Creech; Jerilee Grandy
Educational Testing Service, Princeton, N.J.
Rept. No. PR-74-10 ; 1974 ; 66p 3refs
Availability: Reference copy only

HS-018 211

COMPARISON OF HUMAN DRIVER DYNAMICS IN AN AUTOMOBILE ON THE ROAD WITH THOSE IN

A comprehensive program exploring driver/vehicle system response in lateral steering tasks was initiated in which driver/vehicle system describing functions and other dynamic data were gathered in several milieux. These included: a simple fixed base simulator with an elementary roadway delineation-only display; a fixed-base statically operating automobile with a terrain-model-based, wide angle projection system display; and a full-scale moving-base automobile operating on the road (a 1974 Chevrolet Nova). Dynamic data with the two-fixed base simulators compared favorably, implying that the impoverished visual scene, lack of engine noise, and simplified steering wheel feel characteristics in the simple simulator did not induce significant driver dynamic behavior variations. The fixed-base versus moving-base comparisons showed substantially greater crossover frequencies on the road course, which can be ascribed primarily to a decrease in the driver's effective latency for the moving base. When considered with previous data, the moving-base full-scale versus fixed-base simulator differences are ascribed primarily to the motion cues present on the road course rather than to any visual field differences.

by Duane T. McRuer; Richard H. Klein
Systems Technology, Inc., 13766 South Hawthorne Blvd.,
Hawthorne, Calif. 90250
Contract DOT-HS-359-3-762
1976; 11p 9refs
Prepared for presentation at the 55th Annual Meeting of the
Transportation Res. Board, Washington, D.C., 19-23 Jan 1976.
Availability: Reference copy only

HS-018 212

TEST PROCEDURES AND PERFORMANCE MEASURES SENSITIVE TO AUTOMOBILE STEERING DYNAMICS

A maneuver complex, and related performance measures used to evaluate driver/vehicle system responses as effected by variations in the directional response characteristics of passenger automobiles are described. The complex consists of normal and emergency maneuvers (including random and discrete disturbances) which, taken as a whole, represent all classes of steering functions and all modes of driver response behavior. Measures of driver/vehicle system response and performance in regulation tasks included direct describing function measurements and yaw velocity. In transient maneuvers, measures such as steering activity and cone strikes were used. It is concluded that: measurements of closed loop-driver response characteristics in full-scale road tests showed crossover frequency, phase margin, response latency, and closed-loop damped natural frequency to be important driver response parameters; the key vehicle parameters were the overall steering gain of the car, the gain between the steering angle and the resulting yaw velocity response of the car and the closed-loop path mode time constant which is reflected by the yaw time constant; the key maneuvers were the regulation task, the double lane change, and the emergency lane change; and the key measures for these tasks were driver dynamic per-

velocity dispersion, and driver opinion ratings.

by Richard Klein; Duane McRuer; David Weir
Systems Technology, Inc., 13766 South Hawthorne Blvd.,
Hawthorne, Calif. 90250
Contract DOT-HS-359-3-762
Rept. No. Paper-171; 1975; 14p 6refs
Presented at the 11th Annual Conference on Manual Control,
NASA Ames Res. Center, 21-23 May 1975.
Availability: Reference copy only

HS-018 213

DESCRIPTION AND EVALUATION OF THE NEISS (NATIONAL ELECTRONIC INJURY SURVEILLANCE SYSTEM) REPORTING SYSTEM AS RELATED TO BICYCLE-ASSOCIATED ACCIDENTS. INTERIM REPORT TO BICYCLE MANUFACTURERS ASSOCIATION

The National Electronic Injury Surveillance System (NEISS) is reviewed and evaluated with respect to the sampling methodology employed, the collection and management of the data, and the uses to which the results are put. Regarding bicycles specifically, previous studies in the area are reviewed, and the treatment of the NEISS reporting of bicycle-related accidents is discussed. Recommendations concerning the work to be done during the remaining eight months of the contract period included: extraction of data on individual products in such a way as to decompose the frequency severity index into its component parts; determination of the sensitivity of the NEISS output to differences in both age and severity weighting schemes; establishment of the influence of errors in sampling on the projection of nationwide estimates; and calculation of the estimated variance in the frequencies of accidents estimated for a selected list of products.

by Jairus D. Flora; Richard J. Kaplan; Elizabeth Margoshes
University of Michigan, Hwy. Safety Res. Inst., Huron Pkwy.
and Baxter Rd., Ann Arbor, Mich. 48105
Rept. No. UM-HSRI-SA-75-1; 1975; 50p 11refs
Final report is HS-018 292.
Availability: Bicycle Manufacturers Assoc.

HS-018 215

THE IMMEDIATE IMPACT OF GASOLINE SHORTAGES ON URBAN TRAVEL BEHAVIOR. FINAL REPORT

In response to the gasoline shortage of 1974, a small-scale home interview survey was conducted in an attempt to identify and define changes in the price elasticity of demand for gasoline, procedures for characterizing gasoline supply in travel behavior models, and key implications for the development of transportation and urban design policies. The survey, which was conducted in the northern suburbs of Chicago, Illinois, among households with a high level of automobile ownership, used a questionnaire designed to measure changes in travel behavior, attitudes, and perceptions as a result of the increased price and decreased availability of gasoline. Analysis of the responses to the survey indicate that availability of gasoline was not perceived as being very constrained and that the price increases appeared to have had little importance. As a result, few trips were eliminated. Automobile travel was reduced most by combining trips, such as shopping trips, due

primarily to the inconvenience in purchasing gasoline. The demand for gasoline does not seem to have changed in response to the range of increases in price studied. The consideration of using public transportation was the least common trip decision reported. Car-pooling was almost ignored by the sampled households. It appears that the journey to work is the trip type most resistant to change. The survey results indicate that only an artificially constrained supply of gasoline is likely to reduce consumption significantly, since modest increases in prices do not affect demand to any large degree. In addition, urban planners and public officials should consider educating the public regarding travel behavior options for reducing gasoline consumption, such as increased use of public transportation, and incentives for creating car pools should be considered. Written materials used in the survey, census statistics and a map of the study area, press announcements of the survey, descriptive statistics for all questionnaire variables, and tabulated results of questions about number and types of automobile trips taken are appended.

by Robert L. Peskin; Joseph L. Schofer; Peter R. Stopher
Northwestern Univ., Evanston, Ill. 60201
Contract FH-11-8500
1975; 151p 27refs
Availability: NTIS

HS-018 216

POTENTIAL FOR FLEXICAB SERVICES: INNOVATIVE USES OF TAXIS AND JITNEYS FOR PUBLIC TRANSPORTATION. FINAL REPORT

Used innovatively to provide public transit services, taxis and jitneys can offer mobility in low density areas where mass transit is not feasible, supplement mass transit economically to improve the overall level of service, and promote ridership of regional rapid rail and commuter rail systems and express bus services to reduce the use of private vehicles. Flexicab service refers to the range of demand-responsive and fixed-route services that can be offered as extensions of existing taxi and jitney operations. The experience of the taxi industry in small vehicles, dispatching, and flexible routing makes it particularly suited to flexicab operations. Twenty-three flexicab services are identified, including: demand-responsive services, such as shared taxis, dial-a-ride, transport of handicapped in wheelchairs, and transport of customers of auto repair shops; fixed or semi-fixed route services, including service for inter-city terminals, jitney to the central business district or suburban shopping areas, and late-hour run jitney on bus routes; and delivery services, including telegram delivery, package delivery for local merchants, and delivery of meals-on-wheels. Of these 23 services, it appears to be possible to operate 16 as profit-making ventures by taxi companies or individual owner-drivers. Six of these could provide services at fares within reach of a large ridership if they were publicly subsidized. The remaining seven service options either can be operated by private enterprise with fares set so as to realize a profit or they can be subsidized by some public body. Opportunities for profit are particularly feasible when several types of flexicab services are offered by the same operator, permitting maximum use of personnel and equipment. The following three potential applications of multi-service flexicab systems are described in detail: flexicab as the sole means of public transportation in a small urban area; flexicab as a supplement to a

operating costs, and net earnings. The present status of the taxi and jitney industry is reviewed and recommendations are made for future policy and research.

by Roberta Remak
Interplan Corp., 100 North Hope Ave., Santa Barbara, Calif. 93110
Contract DOT-TSC-748
Rept. No. DOT-TSC-OST-75-52; 1975; 155p 97refs
Report for Apr-Dec 1974.
Availability: NTIS

HS-018 217

HAZARDOUS MATERIALS TRANSPORTATION AND HIGHWAY MAINTENANCE

Reports are given on the essential elements in the transport of hazardous materials, and planning, budgeting, and performing highway maintenance. In the area of transporting hazardous materials, reports feature: characteristics of hazardous materials; reports on Virginia highways; the Chemical Transportation Emergency Center; determining highway shock index; and abridgment of the Transportability Criteria Handbook. In the area of highway maintenance, reports include: United Kingdom developments in highway maintenance since the Marshall Report; user delay cost model for highway rehabilitation; mixed membrane for bridge deck protection; and partial-deprecate concrete patching.

by Joan B. Silberman, ed.
Transportation Res. Board, 2101 Constitution Ave., N.W., Washington, D.C. 20418
Rept. No. TRR-554; 1975; 75p refs
Includes HS-018 218-018 220. Prepared for the 54th Annual Meeting of the Transportation Res. Board.
Availability: Corporate author, \$3.40

HS-018 218

CHARACTERISTICS OF HAZARDOUS CARGO SHIPMENTS ON VIRGINIA HIGHWAYS

The movement of dangerous materials along Virginia highways has caused concern for the potential health and safety hazards to the citizens who live along the routes. For this reason, a study was undertaken to identify the type and frequency of hazardous materials being transported over highways. Analysis of field interviews with 7,591 truckers determine the type of hazardous cargoes, their origins and destinations, and the compliance with the Federal and state regulations regarding warning labels are presented. Results of the study indicate that approximately 3.6 percent of all trucks on Virginia highways contain hazardous materials, most of them carrying flammable liquids.

by N. K. Hook, Jr.; John T. Hanna
Virginia Dept. of Highways and Transportation, Arlington; Virginia Div. of Hwy. Safety, Richmond
Publ. HS-018 217 (TRR-554), Hazardous Materials Transportation and Highway Maintenance, Washington, D.C. 1975 p3-8
1975; 3refs

Prepared for presentation at the 54th Annual Meeting of the Transportation Res. Board. Sponsored by the National Highway Traffic Safety Administration and the Committee on Transportation

HS-018 219

CHEMICAL TRANSPORTATION EMERGENCY CENTER

The Chemical Transportation Emergency Center was established as a voluntary project of the chemical manufacturing industry. It is designed to provide advice or assistance to those involved in transportation accidents involving chemicals. Its services are available 24 hours a day via a toll-free inbound wide area telephone service number from any point in the continental United States. The center is a two-step operation. First, on identification of the product involved, immediate action information is read from files prepared in advance. Second, the shipper or other sources of expertise are contacted for additional counsel or on-site assistance. The nature of the operation and its capabilities and limitations are described. A number of incidents in which the Chemical Transportation Emergency Center has been involved since it began operations in September 1971, are summarized. Relationship of the Emergency Center to the transportation research community is also discussed.

by John C. Zercher
Chemical Transportation Emergency Center
Publ: HS-018 217 (TRR-554), Hazardous Materials
Transportation and Highway Maintenance, Washington, D.C.,
1975 p9-14

Prepared for presentation at the 54th Annual Meeting of the Transportation Res. Board. Sponsored by the Committee on Transportation of Hazardous Materials.
Availability: In HS-018 217

HS-018 220

DETERMINING HIGHWAY SHOCK INDEX

The United States Army, Navy, Air Force and Marine Corps jointly sponsored and participated in the development of a shock index for highway transportation. Vehicles were instrumented to measure shock on the cargo bed of one of a range of trucks, from a two-axle truck, a two-axle truck-tractor, a single-axle trailer combination, and a three-axle truck tractor, two-axle semi-trailer combination. The vehicles were then driven over fixed, unyielding bumps at various speeds at different tire pressures and with different payloads. A numerical shock index, associated with the particular vehicle-payload combination, could then be determined at a low cost by applying simple static field measurements. The shock index provides classification for a vehicle-load combination in regard to probability of shocks transmitted to the cargo during highway shipments.

by John H. Grier
Military Traffic Management Command Transportation
Engineering Agency
Publ: HS-018 217 (TRR-554), Hazardous Materials
Transportation and Highway Maintenance, Washington, D.C.,
1975 p15-20

1975 ; 2refs
Prepared for presentation at the 54th Annual Meeting of the Transportation Res. Board. Sponsored by the Committee on Transportation of Hazardous Materials.
Availability: In HS-018 217

HS-018 221

EFFECTS OF UNDER-THE-HOOD TEMPERATURES ON ELECTRONIC IGNITION SYSTEMS

Influences of wide ranges of temperatures on passive and active devices in the ignition system and resulting timing variations are described. Electrical parameters are emphasized, and the cumulative effect on component tolerances due to different temperature phenomena is presented. Since reliability of the system depends more often on mechanical parameters related to temperature than on electrical parameters, electrical performance as a function of temperature was calculated and the system was designed to meet these requirements.

by Zbynek A. Capurka
Motorola, Inc.
Rept. No. SAE-750163 ; 1975 ; 7p 3refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 222

LIMITS OF RIDE QUALITY THROUGH CAB ISOLATION

A technique for evaluating ride quality as a function of cab isolation parameters is presented. The technique, developed for use in the determination of whole body vibration of the seated operator of agricultural equipment, is applied to a cab-over-engine (COE) tractor to demonstrate the limits of ride quality improvements. An analog computer model has been used to simulate various suspension parameters. Recorded vibrations from a tractor frame are played into a simulated cab. The analog computer output is then analyzed to obtain the frequency spectrum. This spectrum is then weighted and summed to obtain a "ride meter" number. Through numerous repetitions of this process, a curve of ride meter values as a function of cab suspension natural frequency can be obtained. The test vehicle was a 1971 International Harvester CO 4070 tractor with a Hendrickson RTE suspension. A Bruelhauf 4 foot dry freight van was loaded with 20 tons of baled paper and concrete blocks and used to stimulate a typical load. Servo accelerometers were used to obtain cab input acceleration at the frame and cab output accelerations in the cab. Test data were taken at speeds of 55 mph. A two minute segment of the recorded acceleration data was made into a loop and repeatedly played into an analog computer programmed with a cab simulation model. The model accepts as inputs the frame accelerations at the cab hinge and at the rear cab suspension pad. These accelerations are vertical and longitudinal only. Analysis of the simulated cab model indicates that horizontal ride proficiency can be provided at the expense of vertical proficiency in COE tractors. This is due to the fact that generally more vibration is present at the cab hinge than at the rear cab mount. Suspension elements near the rear of the cab can do very little about the energy transmitted through the hinge. In fact, the softer cab suspensions simply reduce the transmitted pitch motion of the frame. To reduce the vertical vibration, a suspension element is needed at the hinge also. It is concluded that this analysis technique has general applicability to ride quality evaluation analysis for any type of

suspension system and provides an excellent tool for measuring relative ride quality of various suspension systems.

by Rush E. Allen
Lord Corp., Lord Kinematics Div.
Rept. No. SAE-750165; 1975; 8p refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 223

HUMAN VIBRATION TOLERANCE CRITERIA AND APPLICATIONS TO RIDE EVALUATION

The development of criteria for human tolerance to vibration is reviewed and practical applications of recommended criteria to ride evaluation are explored with specific reference to the type of measurements made. The International Standards Organization (ISO) has established a standard criteria for human vibration tolerance, which the American National Standards Institute (ANSI) is currently considering for adoption as a U.S. standard. It is suggested that the ISO standard does not represent the best available data. Research, using the most sophisticated equipment and experimental techniques, demonstrated that the subjective response to vibratory motion is a function of the absorbed power, or the rate of energy absorbed internally by the subject's body. The response to a complex vibration can be measured by directly summing the power absorbed by each directional component of the imposed vibration. It is suggested that the concept of absorbed power as an objective measure of subjective response to vibration is the most reliable guide to valid criteria of human tolerance. It is recommended that criteria of vibration acceleration versus frequency for ride comfort approximating the absorbed power characteristics be adopted by the ANSI. In almost all aspects, the ISO comfort criteria depart drastically from the constant absorbed power guidelines. The ISO standard tolerates 2.4 times the recommended acceleration values at the most sensitive frequencies, both vertically and horizontally. Experimental evidence is cited to refute the ISO assumption of a constant multiple of vibration intensity between "comfort" and "decreased performance" and the assumption that "performance" is dependent on time of exposure. Guidelines are presented for instrumentation for use in applying the recommended criteria based on absorbed power to ride evaluation. Data reduction by power spectral density can be used with absorbed power evaluation but requires weighting according to frequency and has the disadvantage of lacking discrimination as to acceleration intensity. The preferred method is a breakdown of data by acceleration counts according to both amplitude and frequency. This can be achieved either by tape analysis or directly from oscillograph records. A sample analysis using actual oscillograph records obtained from two truck tractors is used to illustrate the procedure.

by R. N. Janeway
Janeway Engineering Co.
Rept. No. SAE-750166; 1975; 26p 9refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.

HS-018 225

SEAT BELT USE LAWS: A SOLUTION TO OCCUPANT FATALITY AND INJURY REDUCTION

Recent surveys and investigations provide significant additional evidence that seat belts when worn can provide the greatest vehicle occupant protection of all currently available occupant restraint systems. Seat belts are effective and cost effective, and are universally installed. Acceptable levels of seat belt usage can be attained through appropriate regulatory action requiring improvements in comfort and convenience of seat belt systems, and legislative action by the states to assure usage.

by H. George Johannessen; Charles H. Pulley
Firestone Tire and Rubber Co., Hamill Mfg. Co. Div.;
American Safety Belt Council
Rept. No. SAE-750189; 1975; 11p 28refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 227

ELECTRICAL PROPULSION SYSTEMS FOR BATTERY DRIVEN ROAD VEHICLES WITH HYDRODYNAMIC TRANSMISSION OF POWER

There is a strong desire for electric propulsion systems with low operating voltage due to the fact that in nearly all promising electrochemical energy sources, the cell voltage is lower than in the case of the lead-acid battery. Because of the increasing requirement of inactive material, a high number of battery cells decreases the specific energy storage capacity; that is, the value of the stored energy relative to the material mass. In addition, a low operating voltage is desirable due to safety reasons. A drive system is described which offers the possibility for selecting a lower battery voltage than is the case with the drive systems using armature current controllers. In drive systems using armature current controllers lower operating voltage at identical power is always connected with heavy fall of efficiency and an increase of costs of the semiconductor elements used, which is due to the additional electrical means circuited between battery and motor. The proposed electric propulsion system described involves field weakening of the electric motor to control speed. The function of the power electronics which serves only to control the starting range can be taken over by a hydrodynamic transmission. The design of the drive in this system must take into consideration the basic differences between the torque versus speed characteristics of a hydrodynamic converter and an electric motor. The price for the entire hydraulic converter unit including the accessories required for operation hardly amounts to half the cost of a thyristor in an armature current controller of corresponding power output. It is concluded that an electric drive with hydrodynamic power transmission provides good efficiency of transmission and can meet further demands conditioned by the energy storage.

by C. Bader

HS-018 228

A METHOD FOR ESTIMATING MILEAGE IMPROVEMENT AND EMISSION REDUCTIONS ACHIEVABLE BY HYBRID-ELECTRIC VEHICLES

The results of two derivations relating to the fuel economy of hybrid-electric vehicles (vehicles which employ both a heat engine and electric drive system) are presented, and their use is illustrated through the examples of the University of Wisconsin and the TRW Systems Group hybrid-electric vehicles. The method of mileage estimation employs a specific fuel-consumption versus torque-speed map for the heat engine under study and knowledge of the hybrid-vehicle dynamics and road-load power. The method is extended to estimation of emission reductions through use of specific-emission-production versus torque-speed maps and is applicable to hybrid vehicles with other than electrical energy-storage systems. As work proceeded it became clear that hybrid vehicles with present types of internal combustion engines are not practical. The TRW vehicle was chosen because it is versatile, and when in the urban driving mode, its energy storage system essentially allows the internal combustion engine operating point to be moved from any given point to any other point. In evaluating vehicle parameters, all assumptions were made to yield optimistic efficiency values for hybrid operation. The approach outlined by this study should provide a guide to evaluating developments which could be incorporated into future hybrid vehicle designs. Mileage comparisons between the drive-and-generate hybrid vehicle and the single-powerplant vehicle are appended.

by Thomas A. Nondahl; Donald W. Novotny
University of Wisconsin
Rept. No. SAE-750194 ; 1975 ; 16p 12refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 229

DETERMINATION OF TIRE CHARACTERISTICS FROM VEHICLE BEHAVIOR

An attempt at determining tire-road characteristics from the behavior of a real vehicle is presented. The procedure used involved a full scale semi-tractor-trailer truck operating in a braking and cornering maneuver. The time varying inputs of the drivers to the vehicles is recorded. The information is then used with a computer model of the vehicle, with parameters selectively adjusted by an optimization procedure until the behavior of the actual truck and that of the simulated truck are as similar as possible. Results show that the procedure can provide satisfactory estimates of actual tire characteristics under conditions such as straight line braking, acceleration and steering. Additional work is required in order to determine changes in tire characteristics associated with: modifying maneuver type and duration; changing the objective function; selecting different quantities for measurement in the physical vehicle; errors in measurement of the behavior of the physical

vehicle; changing the tire model in the simulation; and changing the vehicle model in the simulation.

by Allan I. Krauter
Shaker Res. Corp.
Contract DOT-OS-40015
Rept. No. SAE-750211 ; 1975 ; 12p 8refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, Mich., 24-28 Feb 1975. Partly supported by Eaton Corp., Cleveland, Ohio.
Availability: SAE

HS-018 230

CERAMIC ASPECTS OF THE BOSCH LAMBDA-SENSOR

The Lambda sensor is used within the scope of the Bosch emission control system, representing a closed control loop. In principle, it is an oxygen concentration cell with an oxygen ion-conducting solid electrolyte which provides a sharp voltage step at the stoichiometric air-fuel ratio, serving as a control signal. Zirconia ceramic stabilized with certain metal oxides is used as the solid electrolyte. The electrical and mechanical properties of the ceramic depend, above all, on the type and concentration of the stabilizing oxide and on the manufacturing conditions. Using ceramic materials which are described, sensors can be produced that make possible exact control of the stoichiometric air/fuel ratio in a temperature range of 300/400 to 900 degrees C. The lifetime of the sensor, which depends on the operating conditions, can be taken as about 15,000 miles of driving distance. With the sensor, exhaust emissions can be kept below the limits specified for 1977-1978 in the United States. A photograph and a diagram of the sensor are provided.

by Heinrich Dueker; Karl-Hermann Friese; Wolf-Dieter Haecker
Robert Bosch GMBH (Germany)
Rept. No. SAE-750223 ; 1975 ; 20p 13refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 231

AUTOMOTIVE EXHAUST SENSORS USING TITANIA CERAMIC

The resistivity of titania ceramic depends upon the partial pressure of oxygen in the atmosphere surrounding the ceramic. Because there is a functional relationship between the partial oxygen pressure of the equilibrated exhaust gas and the air to fuel ratio (A/F) operating point of the internal combustion engine, the resistance of a titania ceramic sensor, when temperature controlled, can be used to determine quantitatively the A/F. Titania sensors utilizing these principles have been built and found to work particularly well in the region rich of stoichiometry. Control of the A/F in the region rich of stoichiometry is desirable for engine/catalyst systems designed to meet low nitrogen oxides emission levels. Design details and operating features of an experimental titania ceramic sensor and its associated electronic controller are described. Experimental results are reported for the sensor/controller combination operating in engine dynamometer tests and on vehicles with feedback-controlled, electronic fuel injected engines. The

by E. F. Gibbons; A. H. Meitzler; L. R. Foote; P. J. Zaemanidis; G. L. Beaudoin
Ford Motor Co., Scientific Res. Staff
Rept. No. SAE-750224; 1975; 12p 22refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 232

PLATINUM FILM TEMPERATURE SENSORS

A novel temperature sensor, consisting of a composite platinum film firmly bonded to a ceramic substrate, is described. The film is protected from the corrosive effects of gaseous environments by an overglaze of impervious glass, forming a device that is mechanically and thermally robust. Since the sensing unit does not require further protection by encapsulation in a metal or ceramic sheath, it responds very rapidly to thermal changes. The sensor possesses short and long term electrical characteristics similar to those of wire-wound platinum resistance thermometers, but it is less costly. It can operate over a wide range of temperatures up to about 1,000 degrees C. The versatile construction of the sensor renders it, in its cylindrical form, eminently suitable for monitoring the thermal changes occurring within catalyst emission control units on internal combustion engines. Dependent upon associated electronic circuitry, the device can operate visual and/or audio signals and trigger electromechanical functions informing a driver of the condition of these units.

by G. S. Iles
Johnson, Matthey and Co., Ltd. (England)
Rept. No. SAE-750225; 1975; 5p 5refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 233

THE MANUFACTURE OF DISC BRAKE LININGS

The manufacturing techniques used and the process controls implemented in an automated production system for disc brake linings now in operation are described. The primary responsibility of the process is to produce linings repeatedly that meet the engineering specifications and perform in a consistent manner in end point use. The material discussed is organic and composed of eight ingredients. The lining produced weighs approximately 1/3 pounds and projects 10.3 square inches of braking surface. Because the material is organic and composed of approximately 50 percent asbestos, another important engineering objective must be met. The production area where the lining is manufactured must have sufficient air quality to meet the Occupational Safety and Health Act standard for asbestos. The manufacturing operation, complimented with good process and quality control techniques, produces a disc brake lining of extremely consistent performance. The linings produced are reliable parts that meet design specifications and result in consumer satisfaction.

by Gerald R. Russell
General Motors Corp., Delco Moraine Div.
Rept. No. SAE-750228; 1975; 8p
Presented at the Automotive Engineering Congress and Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

METHODS FOR DETERMINING UNOBSERVED AREAS ON INSTRUMENT PANELS

Two methods are presented for determining areas on the instrument panel that are visible through and around the steering wheel rim, hub, and spokes. Both methods are design to that can be used early in the development of new instrument panels to insure that critical displays will not be obscured. Consideration in the design must be given to eye position, head movement; individual and collective obscured areas; visibility requirements as related to display intent and type, such as the speedometer, warning lights and gauge indicators; head movement needed for seeing around an obstruction while causing no measurable reduction in driver performance. Visibility requirements according to display type were selected for and classified according to priority levels. For vehicles operated on public roads, the speedometer is probably most referred to. Therefore, it should not have its visibility compromised by the steering wheel or other secondary displays. When display priority levels are established, visibility requirements can be defined in conjunction with the method selected for displaying the information.

by Ronald W. Roe
General Motors Corp., Design Staff
Rept. No. SAE-750359; 1975; 10p 3refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 235

STUDY ON JAPANESE DRIVER EYE POSITION

A study to measure eye position of the Japanese driver is presented. Test automobiles were three Japanese-produced passenger cars. Subjects were 264 males and 53 females. Range contours of various seatback angles were drawn and compared with the Society of Automotive Engineers' SAE J941c's. In the side view the eye position for Japanese drivers is somewhat to the rear and lower than that of American drivers; the eyellipses for Japanese drivers are slightly larger than SAE eyellipses; and movement of the eyellipse center along the X-direction shows a linear relationship with seatback angle change, but movement along the Z-direction does not. Also, it was found for the sideview that: the angle of rotation of major axes becomes progressively smaller as the seatback angle is straightened to the upright position; and the eyellipse for the design standard seatback angle shows a longer minor axis, a shorter major axis, and a centroid somewhat lower and to the rear compared to the SAE eyellipse. In plan view it was found that: the minor axes of eyellipses of Japanese drivers are shorter than those of SAE eyellipses; the centroid for Japanese drivers are roughly over the seat center line; rotation of major axes for right and left eyes is not parallel, result differing from SAE results.

by Toshiro Ishida; Masanori Matsuno
Japan Automobile Res. Inst., Inc.
Rept. No. SAE-750360; 1975; 10p 14refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 236

SAFETY IN URBAN MASS TRANSPORTATION: RESEARCH REPORT, SUMMARY

A systematic examination of safety in urban mass transportation conducted to provide information and to report results of analyses about the current level of safety and the need for additional safety effort in the field is described. The study was to serve as the conceptual basis for the development of a safety-guidelines manual. Each part of the sequence of investigative steps is briefly discussed: analysis of the current state of safety; determination of acceptable levels of safety; definition of a strategy for safety; definition of a safety program; and analysis of safety trade-offs.

Battelle Columbus Labs.
Contract N00140-73-C-A394
Rept. No. UMTA-R1-06-0005-75-1 ; 1975 ; 16p
See also HS-018 237. Prepared for Urban Mass Transportation Administration, Systems Analysis and Evaluation Div. under subcontract to Naval Underwater Systems Center, Newport, R.I.
Availability: NTIS

HS-018 237

SAFETY IN URBAN MASS TRANSPORTATION: GUIDELINES MANUAL

A series of organizational and technical safety guidelines for urban mass transportation management is presented. The guidelines are intended to show how the transit industry, including supplier firms and system operators, can develop programs that will assure satisfactory operational safety levels. The approach to safety described in this manual is based on five main systematic considerations: the specific meaning of safety in the context of public service systems; the safety problems posed; the goal toward which safety efforts should be directed; the nature of the hazards that must be dealt with; and the locus of responsibility for the safety of urban transportation systems and the extent of its jurisdiction. Problem areas with regard to safety are discussed. Guidelines for planning and operating safety programs in organizations designing, developing, supplying, or operating urban mass transit transportation systems are described. These guidelines include job descriptions for personnel and safety program cost analysis. Engineering and analytical techniques which can be used by transit firms to design and evaluate safety programs are outlined. Trade-offs among various transit system variables which must be considered in the development and implementation of safety programs are discussed. Comprehensive safety data is needed both for the operation of the individual safety program and for use by the transportation industry as a whole. The types of safety standards and specifications available to the transit industry are described and the ways in which the use of the standards interacts with the rest of the industry's safety program are discussed. Safety problems which exist in areas where passengers change from one mode of transportation to another or where urban transportation systems physically intersect or mix with other systems are examined and recommendations are made for safety programs to handle these problems. The guidelines in the above areas are presented in the form of suggested or recommended practices together with explanations. They are designed to have a considerable latitude of user interpretation in order to be applica-

ble to a wide variety of specific situations found in the transit industry.

by E. S. Cheaney; J. A. Hoess; R. E. Thompson; R. L. Svehla
Battelle, Columbus Labs., 505 King Ave., Columbus, Ohio
43201
Contract N00140-73-C-A394
Rept. No. UMTA-R1-06-0005-75-2; G-2460-1 ; 1975 ; 103p
53refs
See also HS-018 236. Prepared for Urban Mass Transportation Administration under subcontract to Naval Underwater Systems Center, Newport, R.I.
Availability: NTIS

HS-018 238

TRAINING OF EMERGENCY MEDICAL TECHNICIANS--AMBULANCE

As estimated in autopsy studies, approximately 20% of crash victims who were pronounced dead on arrival, might have been saved with prompt and effective emergency medical care at the site of the accident. The Critical Care Fellowship of the Department of Public Health of Illinois is seeking to study the effectiveness of training and on-site activities of local emergency pre-hospital systems. An Emergency Medical Technician-Ambulance Training Program was evaluated for effectiveness and level of training. Ambulance incident reports and emergency room evaluation reports were employed in the survey. Based on statistics shown in the followup of reported incidents, prehospital care given to the victims of automobile crashes was found to have been outstanding. Continued improvement of the basic service and skills with frequent critique sessions for standard protocols in hospital and ambulance personnel is recommended.

by Clarence R. Hart; James T. O'Heir
Publ: Illinois Medical Journal p270-3 (Mar 1975)
1975 ; 9refs
Availability: See publication

HS-018 239

STYLING VS. SAFETY: THE AMERICAN AUTOMOBILE INDUSTRY AND THE DEVELOPMENT OF AUTOMOTIVE SAFETY, 1900- 1966

A history of the development of attitudes in the automotive industry towards safety and styling of automobiles is presented. Prior to the mid 1930's, the obligation for traffic safety was not considered to be a concern of the industry. Since that time, however, the stress has been on design to minimize injuries in what are considered to be inevitable accidents. A number of design changes for crash protection were adopted and promoted as minor sales themes during the 1930's, but were dropped during the war years, due to the annual change requirement in styling. After the war, however, increasing criticism of design by physicians, coupled with formal crash injury research by private and governmental industries, refocused attention on the theme of major safety design as a sales angle. Although Congress has given the Federal government the power to regulate automotive safety, there still appears to be no recognition that the total system and entire vehicle, rather than certain aspects of the vehicle itself, will

have to be manipulated in order to deal satisfactorily with the accident problem.

by Joel Webb Eastman
University of Florida
1973 ; 316p refs
Doctoral dissertation.
Availability: Corporate author

HS-018 240

THE PHYSIOLOGICAL EFFECTS OF ALCOHOL ON INDIVIDUALS AND THEIR ABILITY TO DRIVE AN AUTOMOBILE

A series of experiments were conducted to study the physiological effects of alcohol on individuals and their ability to drive an automobile. The design used was a four by six two-way analysis of variance. Groups were chosen to include those individuals who have the most knowledge and skill in handling an automobile, and who have a quick reaction time in different driving situations. These groups included: race car drivers; athletic coaches; athletes; housewives; businessmen; and driver education teachers. A review of literature revealed a degree of impairment somewhere around the level of .05 blood alcohol level. Therefore, individuals were tested at the .01 level; the 0.5 level; the 0.8 level and the .10 level. Acuity vision; field of vision; and night, and glare vision and recovery time were tested on a variety of driving runs including: a figure 8; location stop; serpentine; cone course; and evasive maneuver. The findings of the study supported the following conclusions: blood alcohol level of .05 significantly impairs the individual's ability to perform certain manipulative skills in driving an automobile; as the amount of alcohol in the blood increases, the performance level on a road test decreases; the more complex the driving task, the more apparent the impaired ability becomes; and the recovery time from the glare of bright lights is significantly increased when the blood alcohol level reaches .08. Further implications of the research indicated that driving ability reached a critical point before the individual was aware of his impaired ability; inhibitions were decreased and behavior negatively affecting safe driving emerged; and participants became more susceptible to suggestion as the blood alcohol content increased.

by Lonnie Gilliland, Jr.
University of Oklahoma
1973 ; 182p refs
Doctoral dissertation.
Availability: Corporate author

HS-018 241

HIGHWAY TRAFFIC SAFETY COMMUNICATION: A STUDY OF THE OPINIONS OF MASS MEDIA REPRESENTATIVES IN THE STATE OF MICHIGAN TOWARD HIGHWAY TRAFFIC SAFETY INFORMATIONAL SERVICES

A study was conducted to obtain an attitudinal evaluation of the respondent's professional views regarding the acceptability of highway traffic safety communications received by newspaper, television or radio station. Questionnaires were sent to 270 weekly and 56 daily newspapers; members of the Michigan Press Association; and 170 radio and 25 television stations. Major findings of the study revealed that Michigan's

communications from police, hospitals and similar sources. Radio and television stations received the most useful traffic safety communications from private organizations. Highway traffic safety communications relating to driver practice received highest priority when radio or television stations were considering material for editorials and/or public service time and for newspaper editorial topics, news coverage, and filler. Highway conditions received first consideration for radio and television news coverage. A small segment of Michigan's press (3.85%), radio (5.05%), and television (8.7%) representatives found the "scare" approach unacceptable. Most respondents were inclined to rate the "scare" approach as useful. The greater use of highway traffic safety center material was reported by television representatives. Comments from all respondents indicated the need for continuous, original and localized traffic safety information and materials. Press respondents stress preparation in newspaper style; radio respondents emphasize timing (20-30 seconds); and television asked for videotape color.

by Lloyd Mark Williams
Michigan State Univ.
1973 ; 227p refs
Doctoral dissertation.
Availability: Corporate author

HS-018 242

ENVIRONMENTAL FACTORS AS CAUSATIVE AGENTS IN MOTOR VEHICLE INTERSECTION COLLISIONS

A study of the 10 highest accident density intersections in Oklahoma City for 1972 was conducted in an attempt to identify environmental factors as causative agents in motor vehicle intersection collisions. It was found that nearly all of the intersections studied had one predominant type of collision which was more easily related to environmental factors than driver negligence. It was also found that once the factors were identified, they could be easily remedied, and cost benefited. Areas of improvement included: the design of signal systems and traffic patterns for entire cities to evaluate the effect of improved traffic flow on accident reduction; investigation of the effect of roadside advertisements on driver distraction and inattention; examination of the skid resistant properties of intersection approaches; and relation of this information to prevention of rear-end collisions. The relationship of dawn and dusk periods and visibility problems to accident occurrence and the effect of mass transportation systems on traffic flow and accident occurrence reduction were also demonstrated.

by Douglas R. Lawson
University of Oklahoma
1973 ; 143p 100refs
Doctoral dissertation.
Availability: Corporate author

HS-018 243

TRANSPORTATION FIRE HAZARDS

Fire hazards related to various transportation modes are described. The transport of hazardous materials poses public safety dangers related to fire and other emergencies. Data on the frequency and causes of transport fires involving hazardous cargoes are very incomplete, but information available

causes accidents. Regulations concerning the transportation of hazardous materials tend to lag behind current needs. Often cargo hazard markings do not include all problems posed by the material being transported. Fires in motor vehicles cause almost 35% of all fire deaths in the United States. More than 450,000 vehicle fires occurred in 1971, causing more than 3,500 deaths and an average economic loss of about 200 dollars per fire. In 1971, 729 reported truck accidents involving fire caused 132 deaths, 309 non-fatal injuries, and 7.8 million dollars in property damage. Gasoline spillage is a common cause of vehicle fires, with the most serious losses from fires occurring after rear-end collisions. The location, construction, and security of fuel tanks are therefore important design features for fire safety. It is concluded that vehicles, especially cars, are not as fire-safe as modern technology can allow. Improvements in design and materials could be made without significant additional costs. The National Commission on Fire Prevention and Control recommends that the U.S. Department of Transportation set mandatory standards that will provide fire safety in private automobiles. Aircraft, marine, and railroad transportation fire safety problems are reviewed and recommendations for research and regulations are presented.

Publ: America Burning; The Report of the National Commission on Fire Prevention and Control, Washington, 1973 p85-91
1973 ; 7p 1ref
Availability: In America Burning from GPO \$2.35

HS-018 244

HIGHWAY DESIGN FOR MOTOR VEHICLES--A HISTORICAL REVIEW. PART 4. THE VEHICLE-CARRYING CAPACITY OF THE HIGHWAY

A historical review of investigation into the vehicle carrying capacity of highways is presented. The following areas of capacity research are discussed: the early capacity research of A.N. Johnson and the Maryland Roads Commission including the first estimate of traffic for a connected national traffic network and the first aerial traffic survey in 1927; the Cleveland, Ohio area traffic studies using a device called the traffic flow recorder; theoretical studies in Pennsylvania, Tennessee, and New Jersey; moving picture camera traffic analysis in Michigan in 1930; a 1930 cooperative study of capacities of two-, three-, and four-lane highways by the Maryland Roads Commission and the University of Maryland; a 1934 Ohio State Highway Department study of the working capacity of a two-lane highway using the previously developed photographic method; and the first coordinated effort in 1934 by the Bureau of Public Roads to solve the roadway problem. This latter effort was pushed in several directions simultaneously: development of improved methods for counting and forecasting traffic; lateral placement studies to determine how traffic actually utilizes the road and how it is affected by shoulders and nearby obstacles; passing or overtaking studies to determine distances required for the maneuvers; speed studies of individual vehicles and groups of vehicles; studies of the spacing of vehicles in the traffic stream and how they interact with each other; studies of the hill-climbing abilities of motor vehicles; development of improved instruments for counting vehicles and measuring their speed and position on the highway; and development of methods for analyzing and interpreting huge volumes of factual data gathered in the field. The development of a definition for "capacity" is discussed. With

aid down, completing one of the longest sustained research endeavors in history.

by Frederick W. Cron
Publ: Public Roads v39 n3 p96-108 (Dec 1975)
1975 ; 16refs
Availability: See publication

HS-018 245

ROADSIDE OBSTACLES: THEIR EFFECTS ON THE FREQUENCY AND SEVERITY OF ACCIDENTS: DEVELOPMENT AND EVALUATION OF COUNTERMEASURES

The Road Research Program has two main fields of activity: promotion of international co-operation in road construction, safety and traffic; and a systematic exchange of information on scientific literature. The research group was given terms of reference to categorize obstacles. The general definition for the term "obstacle" is "any natural or man-made feature of the road environment which affects the frequency and the severity of accidents." This, of course, does not exclude a difference between mobile/temporary obstacles (such as dogs, parked vehicles, traffic signals), and permanent fixed obstacles. A survey of available national statistics on accidents involving roadside obstacles and of current national practice in regard to roadside layout was conducted. The report was then broken down to include a review of specific accident studies and experimental tests involving collisions with obstacles, protected or not, and of obstacle protection systems. The review includes particular information on the design of lighting and sign structures and impact attenuating devices.

Organisation for Economic Co-operation and Devel., Rd. Res. Group, Paris, France
1975 ; 125p refs
Includes HS-018 246--HS-018 251.
Availability: OECD Publications Center, Suite 1207, 1750 Pennsylvania Ave., N.W., Washington, D.C. 20006, \$5.00

HS-018 246

IMPORTANCE OF THE PROBLEM AND SURVEY OF NATIONAL PRACTICE

A survey of existing national practice and regulations concerning the location and characteristics of obstacles along the road, and examination of all available data on the effects of roadside obstacles on the frequency and severity of accidents were conducted. National accident statistics show an increase in collision with fixed roadside obstacles. These obstacles were then identified according to each individual country's traffic accident records. It was found that different obstacles were listed under the heading "fixed obstacle." Collisions with parked vehicles were eliminated from the report in order to give a more uniform evaluation. Accident distribution by type of obstacle was then compiled, including trees, posts, walls, buildings, fences, and guard rails, for Belgium, France, Ireland, Italy, Spain, and seven states of the United States. Information regarding current practice for new and existing constructions in the various member countries show that each country has integrated into its design standards the results of engineering studies and research regarding safety. Policies of

these countries provide that priority be given to the considerations of road safety.

Publ: HS-018 245, Roadside Obstacles, Paris, 1975 p12-25
1975; refs
Ch. 2 of Roadside Obstacles: Their Effects on the Frequency and Severity of Accidents; Development and Evaluation of Countermeasures.
Availability: In HS-018 245

HS-018 247

RESEARCH ON ROADSIDE OBSTACLES: ACCIDENT STUDIES

Research on accidents involving a vehicle running off the road and striking a roadside obstacle, or a vehicle hitting an obstacle near the road's edge, is presented. Factors affecting encroachment accidents, such as time of day, driver age, years of driving experience, type of road, lateral movement, encroachment angle, and a comparison between number of tree accidents and number of accidents with other roadside obstacles, were included in the study. Analysis of the obstacle itself, produced accident studies by length of structure, distance from pavement of object struck, cost per accident by speed and object hit, and fatal and injury severity by attenuator type. Studies indicate that more than 80 percent of vehicles running off the roadway had an encroachment angle of less than 20 degrees. Lateral displacement of most of these vehicles was not more than ten meters. It was found that conventional improvements using normal road design measures had only a small effect on the frequency and severity of encroachment accidents. Possible solutions at present seem to lie in the elimination or displacement of obstacles further away from the roadside, or in making them less aggressive by modifying or protecting them using guardrails or impact attenuators. General accident features, such as the effects of age, alcohol, and so forth, were the same in all accidents with roadside obstacles. However, there are differences regarding the effect of average daily traffic in that the relative importance of a single vehicle accident decreases with increasing traffic volume.

Publ: HS-018 245, Roadside Obstacles, Paris, 1975 p26-49
1975; refs
Ch. 3 of Roadside Obstacles: Their Effects on the Frequency and Severity of Accidents; Development and Evaluation of Countermeasures.
Availability: In HS-018 245

HS-018 248

RESEARCH ON ROADSIDE OBSTACLES: EXPERIMENTAL STUDIES

Research results dealing with impact tests involving obstacles and impact attenuator systems are reviewed. The main objective of the tests was to ascertain whether or not the protective structure used works in a satisfactory manner. One of the problems in the research is the fact that most of the tests were conducted in the United States, and therefore are affected by the type of private automobile and existing road equipment. For instance, most of the lighting columns found in the United States have a transformer base which can rarely be found in the other countries studied. Further experimental studies are

ments; and economic constraints. The solutions described in the studies, nevertheless, are of interest. The effectiveness of break-away designs for lighting columns, and in particular that of the slip base were shown. The application of the slip base can be seen as the solution to a great number of obstacles, such as lighting columns, gantry structures, and signposts. It is likely that the impact attenuators will be used to a greater degree in future construction of guardrails. The research also uncovered a need for developing a systematic set of evaluation criteria and standardized test conditions for the assessment and further development of impact-safe road equipment.

Publ: HS-018 245, Roadside Obstacles, Paris, 1975 p50-7
1975; refs
Ch. 4 of Roadside Obstacles: Their Effects on the Frequency and Severity of Accidents; Development and Evaluation of Countermeasures.
Availability: In HS-018 245

HS-018 249

ECONOMIC ASPECTS [ROADSIDE OBSTACLES]

Safety programs to study the problem of accidents involving roadside obstacles have taken on major importance, and the increasing cost of such programs has made it necessary for authorities to conduct a thorough analysis of the consequences of decisions made by such program studies. The studies are concerned with establishing the cost of any measure adopted (including initial investment, maintenance and operation), and evaluating the benefits derived from adopting the measure. The relationship is translated into terms of cost to benefit, or cost effectiveness. In determining the cost of accidents, it is usual to consider material damage, medical expenses, police and court expenses, insurance costs, administrative costs, and loss of production due to injury, disablement and death. Evaluation of costs in participating countries varies greatly, but in several places it was considered realistic to figure the following costs: 200,700 dollars for a fatal accident; 7,300 dollars for an injury; and 300 dollars for material damage. By comparing accidents occurring in a control zone with those occurring in the zone after the application of safety measures (removal of trees or roadside obstacles, placement of guardrails, relocation of traffic signs, and so forth), an estimate can be made of what would have happened in the absence of the safety measure. Two such programs, the Clean up the Roadside Environment program in California, and the French "safety operation No. 5" are examples. The California program concluded that an investment of about 20 million dollars to cover the removal, conversion to frangible design, or the protection by crash barriers of isolated obstacles alongside the California freeways, could save an estimated 500 human lives

Publ: HS-018 245, Roadside Obstacles, Paris, 1975 p58-64
1975; refs
Ch. 5 of Roadside Obstacles: Their Effects on the Frequency and Severity of Accidents; Development and Evaluation of Countermeasures.
Availability: In HS-018 245

HS-018 250

CONCLUSIONS, RECOMMENDATIONS AND FUTURE WORK [ROADSIDE OBSTACLES]

termesures has concluded that the frequency and severity of accidents can be reduced by simple and relatively inexpensive measures aimed at improving the roadside. As far as the roadside environment is concerned, the following principles were suggested for adoption: elimination of all obstacles from the roadside; modification of structures of obstacles which can not be removed so as to render them harmless if struck by a vehicle; or giving effective protection to obstacles that can not be modified. Programs implemented for roadside safety should be distinguished according to those programs for roadside clearance, and those involved in new highway construction. Measures used to modify or reduce roadside obstacle impact in automobile accidents are: the use of guardrails; the use of impact attenuators; embankments and cuts; ditches; and impact testing. Future research should focus on accident studies before and after implementation of a safety measure; study of real accidents aimed at reducing the frequency of run-off accidents; and research on primary safety. Secondary safety research can focus on removing unnecessary obstacles; displacing obstacles; modifying the structure of obstacles and vehicle improvements.

Publ: HS-018 245, Roadside Obstacles, Paris, 1975 p65-73
1975

Ch. 6 of Roadside Obstacles: Their Effects on the Frequency and Severity of Accidents; Development and Evaluation of Countermeasures
Availability: In HS-018 245

HS-018 251

APPENDICES. [A-E. ROADSIDE OBSTACLES]. A. PROTECTION OF OBSTACLES BY GUARD RAILS IN GERMANY AND FRANCE. B. SOME POLICIES PRACTISED [PRACTICED] IN EUROPE REGARDING ROADSIDE TREES. C. RESEARCH ON LIGHTING COLUMNS. D. RESEARCH ON TRAFFIC SIGN POSTS. E. RESEARCH ON IMPACT ATTENUATION SYSTEMS

A description of the requirements for protection of obstacles by guard rails in Germany and France is presented in Appendix A. For large obstacles, close to the roadside, the guardrails are mounted offset on the obstacle itself or fixed directly on the obstacle. Guardrails are also installed near rivers, wells, reservoirs, and railways or other traffic facilities. Appendix B describes some of the policies practiced in Europe regarding the spacing of roadside trees, with consideration given to limited felling of trees, or transplanting the trees farther back from the road edge. Appendix C provides a summary of research on lighting columns, after a series of frontal and lateral impact tests. Analytical testing and mathematical models to study lighting columns were also developed. The research on traffic sign posts in Appendix D showed that with single post signs in impacts below 70 kilometers per hour, the automobile will most probably sustain a secondary impact in the region of the windshield. Lighter vehicles decelerate so rapidly that there is a great risk of injury. Research results on the following impact attenuation systems are included in Appendix E: metal drums; lightweight concrete blocks; shock absorbers; sand filled barrels; water-filled cylindrical cushions; and scale models and mathematical studies designed to study

the effectiveness of the attenuator systems. Detailed schematics of the various attenuator systems are provided.

Publ: HS-018 245, Roadside Obstacles, Paris, 1975 p80-119
1975 ; refs

In Roadside Obstacles: Their Effects on the Frequency and Severity of Accidents; Development and Evaluation of Countermeasures.

Availability: In HS-018 245

HS-018 252

EFFECT OF TRICYCLIC ANTIDEPRESSANTS AND ALCOHOL ON PSYCHOMOTOR SKILLS RELATED TO DRIVING

Twenty healthy subjects (20-25 years old) took amitriptyline, doxepin, and placebo for 2 weeks each in a double-blind crossover trial, and another 20 subjects similarly took nortriptyline, chlorimipramine, and placebo. The antidepressants were given three times daily in doses generally used for neurotic patients. The presence of antidepressants in tissues was checked with the tyramine pressor test. On the seventh and fourteenth days of each period, psychomotor skills (choice reaction, coordination, and attention) were measured after the administration of drugs in combination with an alcoholic or placebo drink. Dose-response graphs for the tyramine pressor effect were shifted to the right during the antidepressant treatment, indicating a blockage of the membrane pump in peripheral sympathetic terminals. This antityramine effect of antidepressants did not correlate with their psychomotor effects. No drug alone importantly impaired psychomotor skills. Amitriptyline in combination with alcohol increased cumulative choice reaction times, and doxepin in combination with alcohol increased both cumulative choice reaction times and inaccuracy of reactions. Coordination was impaired after both of these combinations on the seventh day. It seems as if doxepin and amitriptyline but not nortriptyline or chlorimipramine, in combination with 0.5 grams per kilogram body weight of alcohol, may be especially dangerous in driving.

by Timo Seppala; Markku Linnoila; Erkki Elonen; Mauri J. Matilla; Martti Maki

Publ: Clinical Pharmacology and Therapeutics v17 n5 p515-22
(May 1975)
1975 ; 20 refs

Availability: See publication; T. Seppala, Department of Pharmacology, Siltavuorenpenger 10 A, SF-00170 Helsinki 17, Finland

HS-018 253

LOCATING DETECTORS FOR ADVANCED TRAFFIC CONTROL STRATEGIES. HANDBOOK. INTERIM REPORT

A handbook for locating detectors for advanced traffic control strategies is presented. A discussion of criteria is given and procedures for locating detectors to provide required surveillance data are described. The procedures relate to locating detectors at critical intersections, assessing which link in the network requires detectorization, and locating detectors within the link. Both latitudinal and longitudinal placement within the link are discussed. The procedures were developed as part of the continuing research for the Urban Traffic Control System/Bus Priority System, in Washington, D.C., but are ap-

plicable to the more general detector locating studies for traffic control systems.

by J. L. Kay; R. D. Henry; S. A. Smith
JHK and Associates, Suite 1112, 4660 Kenmore Ave.,
Alexandria, Va. 22304; Peat, Marwick, Mitchell and Co., 1025
Connecticut Ave., N.W., Washington, D.C. 20036
Contract FH-11-8242
Rept. No. FHWA-RD-75-91; 1975; 50p 6refs
Availability: NTIS

HS-018 254

THE EFFECT OF COMMERCIAL VEHICLES ON DELAY AT INTERSECTIONS

The results of a study of the effects of commercial vehicles on intersection delay are reported. The delay effects of commercial vehicles on through traffic at signalized intersections and the effect of intersection corner radii on right-turning speeds of commercial vehicles were determined. Commercial vehicles were defined as any vehicle having at least 6 tires and 2 or more axles. Data were collected at intersections in five Indiana cities. Twenty-three intersection approaches were studied for commercial vehicle delay and 19 intersection corner radii were studied for right turn speeds of commercial vehicles. It was found that: a passenger car's average running travel time through a signalized intersection was increased from 39.9 to 49.4 seconds, when one or more commercial vehicles were traveling ahead of it in the same group of vehicles; the factors or variables having a significant effect on increasing delay are peak hour volume, percent of commercial vehicles, the presence of a left turn green phase, the presence of a right turn only lane, and the approach width; the factors having a significant effect on reducing delay are the presence of a left turn only lane, the percent of right turns, the right turn curb radius, the metropolitan area population, and the presence of curbing on the approach; the maximum right turn speed for a truck combination at a signalized intersection is approximately 14 mph and about 15 mph for a single unit truck; the presence of curbing at the intersection approach was found to decrease the right turn speed of passenger cars and combination trucks by .7 and .9 mph respectively; and 30 and 60 foot intersection corner radii were optimum for single-unit and truck combinations respectively.

by Thomas H. Yurysta; Harold L. Michael
Proudfoot and Associates, Inc., Toledo, Ohio; Purdue Univ.,
West Lafayette, Ind.
Rept. No. JHRP-76-3; 1976; 31p 11refs
Prepared for Presentation at the January 1976 Meeting of the
Transportation Res. Board. Based on JHRP research study
final report, The Effect of Commercial Vehicles on
Intersection Capacity and Delay, JHRP-74-8, June 1974.
Availability: Reference copy only

HS-018 255

EVALUATION OF FACTORS INFLUENCING DRIVEWAY ACCIDENTS

Characteristics of driveway accidents are identified and driveway accident occurrence is related to various physical and environmental features of the roadway and traffic characteristics. Driveway-related traffic accidents account for almost 14% of all arterial highway traffic accidents. Through statistical analysis it was shown that the driveway accident rate tends

between a driveway and an adjacent intersection increase. Multiple regression analysis was used to develop a series of mathematical models relating the driveway accident rate to roadway features and traffic characteristics. The driveway accident rate was found to decrease if the number of commercial driveways per mile is decreased, if the number of through-traffic lanes is decreased, if the number of total intersections per mile is increased, if the number of total driveways per mile is decreased, or if the arterial highway average daily traffic decreased. Results of this study provide the engineer or public official with the tools enabling him to better identify the circumstances related to driveway accidents, to predict driveway accidents rates, and to estimate the effectiveness of measures he employs to reduce such accidents.

by William W. McGuirk; Gilbert T. Satterly, Jr.
District of Columbia Dept. of Transportation, Purdue Univ.,
West Lafayette, Ind.
Rept. No. JHRP-76-1; 1976; 31p 2refs
Presented at the 55th Annual Meeting of the Transportation
Res. Board. Based on JHRP research study final report,
Evaluation of Factors Influencing Driveway Accidents JHRP-
Report No. 10, May 1973.
Availability: Reference copy only

HS-018 256

AN AUTOMATIC DATA ACQUISITION SYSTEM OF VEHICLE CONTROL AND ROAD HOLDING

An automatic data acquisition system that shows the interactions between giving driving controls and vehicle motion response is described. Through the use of this system, it is possible to record and represent in real time the motion characteristics and the trajectory of one or more test vehicles on an equiplanar, wide extended square fully equipped test track. Vehicle position is determined by a magnetic detector sensitive to the frequencies of electric currents running through conductors imbedded in a network under the track. Electronic equipment on the test vehicle analyzes pulses sent in by the detector and records the instant when the detector crosses over a wire in the test track and the direction of the vehicle. The signals can be recorded on magnetic tape or transmitted by telemetry. The system has been proven effective and constitutes a new and valid data acquisition system concerning the driveability of vehicles. Circuit diagrams of electrical networks involved in the system and photographs of an equipped test vehicle and the test track are provided.

by F. Moscarini
Istituto Sperimentale Auto e Motori S.p.A. 03012 Anagni (F)
Italy
n.d.; 29p
Availability: Corporate author

HS-018 258

AN ALTERNATIVE TO THE ROLL AXIS FOR USE IN COMMERCIAL VEHICLE SIMULATION

It has been assumed that the roll motions of a sprung mass take place about a roll axis. Equations of motion based on this assumption must be expected to exhibit dynamic coupling significant complication in the case of digital computer simulations of multi-unit vehicles. Digital simulations have been developed which preserve the physical character of the axis, propagation, while using further approximations to

formed which demonstrate the accuracy of this methodology. Testing to validate articulated vehicle braking and handling simulation for commercial vehicles was performed with an articulated vehicle, and for the most part, the validation effort was as successful as indicated. Testing to validate simulated performance of passenger cars was also performed with a 1971 Dodge Coronet and a 1971 Chevrolet Brookwood station wagon. In conclusion, the simulations preserved the physical character of the roll axis; used approximations to avoid dynamic coupling traditionally found in a roll axis formulation; and validation exercises demonstrated the accuracy of this methodology.

by James E. Bernard

Publ: Vehicle System Dynamics v4 n4 p211-22 (1975)
1975 ; 7refs

Presented at the Third International Conference on Vehicle System Dynamics, VPI and SU Blacksburg, Aug 1974.

Availability: See publication

HS-018 261

THE ECONOMIC COST OF COMMUTING

An updated comparison of the economic costs of commuting to the central business districts of major United States metropolitan areas is presented. Examples of economic costs of personal travel to and from work in the central business districts of the 33 urban areas of more than one million population are compared. The direct economic transportation costs of commuter trips by rail transit, bus transit and private automobiles are estimated singly and in combination. Results are in terms of dollars per one-way person trips of 5, 10, 15, and 20 miles. A detailed discussion of the 10-mile trip is presented in order to illustrate the approach used. Details of the urban travel cost analysis divided by mode (automobile, van, rail, and bus), summaries of automobile and van costs, the economic costs of travel by the three basic classes of automobile (standard, compact, and subcompact), and rail transit costs for the 10-mile trip are appended. Travel examples elaborated in the study are typical of transportation alternatives most likely to be available over the next 20 years. The results, therefore, give a general perspective of the relative economic cost of the various forms of downtown-oriented commuter travel in large metropolitan areas. This would aid public officials in determining what means would be most acceptable to alleviate one of the nation's most serious transportation problems: peak hour congestion.

by Marshall F. Reed, Jr.

Highway Users Federation, Transportation Devel. Div., 1776 Massachusetts Ave., N.W., Washington, D.C. 20036

Rept. No. Tech-Study-Memo-13 ; 1975 ; 64p 25refs
Availability: Corporate author

HS-018 262

A BICYCLE SAFETY PROGRAM GUIDELINE FOR PARENTS ORGANIZATIONS

The bicycle accident problem is discussed and data conclusions on bicycle facilities, usage, accidents, fatalities, thefts, and safety measures are surveyed. California state laws for bicyclists are also listed. A number of suggested safety programs designed to be put on by parents' organizations are discussed: assembly programs for schools and parents groups; a bicycle safety poster program; bike rallies and decathlons;

bike rides and clubs for group riding; the sponsorship of bicycle licensing; sponsorship of a puppet show; sponsorship of a bikathon; and safety checks with a bike maintenance clinic. A list of available resource material is provided.

City of San Jose, Bicycle Safety for Santa Clara County Proj., 460 Park Ave., Room 103, San Jose, Calif. 95110

1977 ; 37p

Availability: Corporate author

HS-018 263

A RESEARCH DESIGN TO COLLECT DATA FOR A SECOND GENERATION EYELLIPSE

Current automotive design practices related to driver visibility are based on static laboratory studies of mostly straight ahead viewing that were conducted by researchers beginning in 1962. These individual studies have never been replicated either in the lab or in actual driving situations to determine the validity of their procedures. After a thorough review of the literature related to driver eye location and a statistical analysis of previous static eye location data, an experimental design is proposed to determine dynamic eye location distribution characteristics. The design provides information on the relationship of static anthropometric measurements to dynamic eye location; the difference between dynamic on-the-road eye location versus static in-the-lab eye location distributions; the effect of different types of vehicle seating package parameters on eye location; and a validation of previous static eye location studies. The data obtained from the experimental design could be used to verify or replace the Society of Automotive Engineer's Eyellipses. Also, it would allow for the development of a mathematical model that will describe eye positions during the driving task as a function of package variables, driver anthropometry, and target viewing angles.

by James M. Miller; Susanne M. Gatchell
University of Michigan

Rept. No. SAE-750362 ; 1975 ; 12p 22refs

Presented at the Automotive Engineering Congress and Exposition, Detroit, Mich., 24-28 Feb 1975.

Availability: SAE

HS-018 264

COMPARISON OF EYE FIXATIONS OF OPERATORS OF MOTORCYCLES AND AUTOMOBILES

The eye fixations of two motorcyclists who drove a motorcycle and an automobile on two lane rural roads at 45 miles per hour, in daylight, were measured. The effects of road edge delineation, road geometry, on-coming vehicles, and the factor of whether or not the drivers were controlling a motorcycle or an automobile, were evaluated in terms of the manner in which the drivers used their eyes to obtain visual information. The results indicated that most of the drivers' attention was directed within 5 degrees of the forward line of sight, but on curves, the drivers' eye fixations shifted in the direction of the curve. When an oncoming vehicle appeared, the drivers spent a substantial proportion of the viewing time looking at it periodically. The mean duration of glances were longer for these drivers when operating a motorcycle than an automobile. When operating the motorcycle, there were relatively more glances made closer to the vehicle than when driving the car, suggesting that motorcyclists are more concerned with irregularities, composition and frictional characteristics of the pave-

ment surface. The motorcycle rider also tended to view along the right side of the lane more than when driving the car. Comparisons made between the eye fixations of these motorcyclists when driving an automobile and those of other drivers of an automobile indicated considerable agreement, except that the motorcyclists attended more to oncoming vehicles. The results of the study are used to infer the type of distribution of illumination required from motorcycle headlamps for night driving. The beam pattern of motorcycle headlamps should be somewhat different than that provided automobile drivers, particularly in that good foreground illumination is required for visibility of the surface characteristics of the pavement. The beam should also emphasize the right edge of the road.

by Rudolf G. Mortimer; Craig M. Jorgeson
University of Michigan, Hwy. Safety Res. Inst.
Contract DOT-HS-4-00 907
Rept. No. SAE-750363; 1975; 8p 5refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 265

CLOSED-LOOP ELECTRONIC FUEL AND AIR CONTROL OF INTERNAL COMBUSTION ENGINES

Utilizing a closed loop electronic fuel injection (EFI) system with an oxygen (λ) sensor as a feedback element, techniques are demonstrated to expand the air/fuel operating range up to 10% from a stoichiometric calibration. A closed-loop test vehicle was placed on a chassis dynamometer equipped to provide a step input excitation of 42 degrees to the throttle valves. The response of the engine was recorded along with other variables. Fuel injection timing techniques, such as "simultaneous double fire," were presented which further enhanced the transient engine response of EFI vehicles. A closed loop air control system operating with the EFI system is discussed. The system has resulted in improved idle-speed control during cold- and warm-engine operating conditions. Other techniques, such as the "gain rate" technique, allowed the closed-loop system to operate at the triple point of the three-way catalyst while utilizing the most durable switching voltage of the oxygen sensor. The "limit control" technique demonstrates an approach for additional biasing from stoichiometric air/fuel ratio of approximately 10%.

by John Camp; Todd Rachel
Bendix Corp.
Rept. No. SAE-750369; 1975; 14p 5refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 266

THE FUNCTION AND PERFORMANCE OF BETA ALUMINA IN SODIUM/SULPHUR CELLS

The development of beta alumina ceramic in terms of its function as an electrolyte and physical separator in sodium/sulfur cells is traced. In the sodium/sulfur cell, the beta alumina ceramic physically separates the molten reactants. Ability to retain mechanical integrity is a basic necessity for a period of at least 3 years at an operating temperature of 350°C when chemical attack will be accelerated. Assuming this to be

beta alumina must satisfy the requirements, for example, for handling and assembly into a cell and battery, differential pressures set up during cell operation, and for compatibility with seals. One of the features associated with the failure of the sodium/sulfur cell is the formation or penetrating of metallic sodium in the solid electrolyte. Examination of beta alumina after passage of current reveals two distinct types of sodium occurring from the sodium/beta alumina interface, one being grey filaments passing through the thickness of the beta alumina and the other a band of general darkening of the material. By substituting a change in composition in the beta alumina manufacturing process, a material has been produced which so far shows virtually no sign of electronic breakdown during cell testing. When this material is tested in a sodium/sulfur environment, the cell resistance remains constant. It is concluded that the optimum performance of the beta alumina electrolyte is dependent on its composition.

by M. D. Hames; J. H. Duncan
British Railways Board
Rept. No. SAE-750375; 1975; 14p 9refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 267

THE VARIABLE RATIO MASTER CYLINDER--A DESCRIPTION OF ITS FUNCTION AND OPERATION

The concept of an improvement in work utilization by modification of the hydraulic brake master cylinder currently employed in production of automotive vehicles is presented. This improvement, which is in the form of a variable ratio master cylinder having the advantage, among others, of reducing intermediate and final brake pedal efforts without the need for an external assist, is explained. The variable ratio master cylinder is similar in external appearance to a conventional master cylinder, but it has an additional bore whose centerline is collinear with the centerline of the primary bore, and is known as a boost bore. Brake pedal efforts may be varied to meet individual objectives by changing the diameter of the boost bores. Where undesirably high brake pedal efforts, reduced engine compartment size, or inefficient, high cost or non-existent external power assists are an impediment to the realization of an efficient brake actuation system, the variable ratio master cylinder provides a satisfactory alternative without the major disadvantages.

by R. L. Nigg; A. W. Palmer; R. F. Green
Borg-Warner Corp., Borg and Beck Div.
Rept. No. SAE-750382; 1975; 11p
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 268

BRAKE FLUID FUNCTIONABILITY IN CONVENTIONAL AND ANTI-SKID SYSTEMS IN ARCTIC CONDITIONS

The effect and description of vehicle braketest performance under conditions of low ambient temperature and the evaluation of the effect of brake fluid viscosity, under these conditions, on brake system performance are presented. Vehicle braking tests were performed within the Arctic Circle. Brake

fluids with viscosities up to 1.48 times .001 square meters per second at ambient temperatures down to minus 30 degrees C have no adverse effect on braking when used in either conventional or anti-skid brake systems under road conditions normally encountered at these low ambient temperatures.

by David Brown; Colin Harrington
Burmah Castrol Co., Res. Lab., United Kingdom
Rept. No. SAE-750383 ; 1975 ; 6p 2refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, Mich., 24-28 Feb 1975. Prepared in cooperation with Girling Ltd.
Availability: SAE

HS-018 269

HYDRAULIC POWER BRAKE BOOSTER FOR SMALL CARS

A hydraulic power booster which has been developed for small automobiles and which utilizes the power steering pump as a power source, is presented. The unit provides higher master cylinder pressures and lower pedal efforts to aid in meeting regulations set by the National Highway Traffic Safety Administration. In addition, the booster configuration provides a smaller and lower weight package than similar units and provides a ratio change feature. Features worthy of emphasis include: hydraulic travel ratio change and travel limiters that are concentric in design, which allow for simplification in packaging and manufacturing, plus a solid and secure feeling column link between the input and output push rods; a poppet type inlet and exhaust valve which minimize susceptibility to contaminated fluids; a hydrostatically controlled gain valve providing simplified packaging and minimized interaction between steering and braking; and a package design which allows for interchangeability of mounting flanges to adapt to different firewall configurations and master cylinder mounting flanges with minimum tooling modifications.

by Kenneth B. Swanson
Midland-Ross Corp.
Rept. No. SAE-750384 ; 1975 ; 7p
Presented at the Automotive Engineering Congress and Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 270

STEPPED BORE MASTER CYLINDER--A WAY OF IMPROVING DUAL BRAKE SYSTEMS

Dual brake systems are required in motor vehicles in the United States. These systems increase the safety of motor vehicles by overcoming the loss of braking effect which occurs when a brake pipe or hose in a single-circuit system breaks. However, a disadvantage of the dual system is the extra pedal movement and increased pedal force which are required when one circuit has broken down. Since the maximum deceleration which can be obtained is dependent on the largest pedal force that the driver can produce, or the maximum friction force which can be exerted at the braked wheels, a deterioration in deceleration normally occurs when one circuit breaks down. A dual brake system which includes a tandem master cylinder was introduced on the Volvo 144 in 1966. This system still caused rather large pedal stroke losses when one circuit broke down, resulting in a feeling of unresiliency in the pedal. A new type of master cylinder was in-

this new cylinder is based on the use of two pistons, loosely connected with one another, and with different diameters, in one cylinder. When the brakes are applied with an intact system, the pressures in both circuits are the same. The pressure equalization necessary to obtain the same pressure in both circuits is achieved in the stepped bore master cylinder with a secondary piston, which floats within certain limits. The stepped bore master cylinder gives high brake fluid pressure with a moderate pedal force with one circuit out of function. It is probably most suitable when used with disc brake systems. With drum brakes, a good automatic adjusting device is needed.

by Ante Larsson; Lars Larsson
AB Volvo
Rept. No. SAE-750385 ; 1975 ; 8p
Presented at the Automotive Engineering Congress and Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 271

PASSIVE AND ACTIVE RESTRAINT SYSTEMS--PERFORMANCE AND BENEFIT/COST COMPARISON

Five different restraint systems--mandatory harness, airbag plus 20 percent lap belt usage, airbag, passive three point harness, and torso and knee bar--are analyzed for fatality and injury reduction, benefit/cost ratio, and cost effectiveness. The mandatory harness is superior to the others in all comparisons with approximately 100,000 lives saved over the first 10 years which is about twice as many as would be saved by the other systems. A major advantage of the mandatory harness is that practically all of the vehicles are equipped while the other systems will require 10 years for complete installation. The use of the air cushion should not be required until field experience shows it to be effective. The mandatory harness also showed the lowest cost, and the highest benefit/cost ratio when compared by the other systems.

by L. M. Patrick
Wayne State Univ.
Rept. No. SAE-750389 ; 1975 ; 16p 21refs
Presented at the Automotive Engineering Congress and Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 272

PASSIVE VS. ACTIVE 0 [EQUALS] LIFE VS. DEATH

The relative success of passive and active crash protection devices in motor vehicles is discussed. While active measures attempt to stop injury-threatening contacts between people and their environments by modifying the behavior of the people, passive measures attempt to stop such contacts by modifying the behavior of the environment. The most effective modifications in vehicle crash involvement crashworthiness factors during recent years have been the development of such passive equipment as the energy absorbing steering column, the laminated non-popout windshield, dashboard cushioning, improved bumper systems, and improved backup braking systems. It is suggested that active countermeasures now in use should be replaced with passive devices. These improvements could include the replacement of safety belts with passive restraints, of posted maximum 55 mph speed limits with

engines with designed-in speed maxima, and of adjustable head restraints with non-adjustable designs. It is concluded that passive approaches have been associated with great and lasting effectiveness in terms of lives saved and injuries reduced, while active approaches have been associated with far lower levels of payoff in the prevention of death and injury when people come into contact with potential hazards. It is recommended that in Federal motor vehicle safety regulation and manufacturer design decisions a criterion be imposed calling for the adoption of an essentially passive approach in every case unless it can be shown that no such approach exists.

by A. B. Kelley
Insurance Inst. for Hwy. Safety
Rept. No. SAE-750391 / 1975 / 14p 12refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 273

EVALUATION OF TWO CONVEX MIRROR SYSTEMS BY GOVERNMENT DRIVERS

A nationwide field study of two types of convex mirror systems was made by the National Highway Traffic Safety Administration (NHTSA) with the cooperation of the General Services Administration (GSA) for a 10 month period starting in January 1974. One convex mirror system, known as the Type 1 system, consisted of a non-adjustable convex mirror on the right fender, the original outside mirror on the driver's door, and a larger inside mirror. The Type 2 mirror system consisted of an adjustable convex mirror mounted on each fender and the original inside rearview mirror. A total of 515 Federal employees evaluated these two convex mirror systems at six major test locations to provide 627 questionnaires. An analysis of the questionnaires shows that drivers preferred the Type 2 convex mirror system over the Type 1. From comments received, it seems that the drivers objected mainly to the non-adjustable feature and restricted field of view of the Type 1 system rather than to the fact that it was only a one-convex mirror system as compared to a two-convex mirror system. However, neither convex mirror system was rated as highly as the periscope system which was evaluated in a previous field test of 50 automobiles. This suggests that drivers would prefer unit magnification mirror systems with larger rearward fields of view over convex mirror systems with roughly the same view. Drivers also prefer the convex mirror systems over conventional mirror systems because the convex mirrors provide greater rearward visibility.

by Charles H. Kaehn
Department of Transportation
Rept. No. SAE-750472 / 1975 / 11p 13refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 274

OCCUPANT PROTECTION...BACK TO THE BASICS

A structured reorientation to the basics of occupant protection with restraint systems is presented. A general assessment of the various kinds of restraints as they relate to those basics is

cushions; full crash mode air cushions; passive belts and belt improvements; and inflatable belts. After examining the systems, some fundamental conclusions began to take shape: a new system doesn't necessarily mean a better system; increased sophistication or system complexity, while solving some problems, often can introduce greater problems, especially if there is inadequate development and test time; singularity of approach may restrict technological developments that may have yielded greater benefits; and a reassessment of the basics from time to time serves to maintain a favorable perspective in ordering priorities. The basics of an effective restraint system are those which: consider the limits of the passenger compartment integrity; are designed with some capacity for growth with the vehicle; are practical to implement; are configured for occupant comfort and convenience; are oriented towards all types and sizes of people; and are designed for accidents in the field, and not merely fixed barriers.

by Philip D. Vrzal
Chrysler Corp.
Rept. No. SAE-750394 / 1975 / 11p 5refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 275

DETERMINATION OF RESTRAINT EFFECTIVENESS. AIRBAG CRASH TEST REPEATABILITY

Thirty-three airbag-equipped 1972 Mercury automobiles were crash tested at three different test laboratories in order to determine the repeatability of test results in the proposed Federal Motor Vehicle Safety Standards (FMVSS) 208 procedure. Twenty-four of the cars were frontally crashed into perpendicular and 30° rigid barriers. Nine Hybrid-II crash dummies were used. Significant inconsistencies in results from the three testing agencies were reported. There was a large component of test variability due to uncontrolled and generally unknown factors operating in each test crash. On the average, differences from one test dummy to another contributed comparatively little to the unrepeatability of test readings.

by John Versace; Roger J. Berton
Ford Motor Co.
Rept. No. SAE-750395 / 1975 / 11p
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975. Prepared in
cooperation with Calspan and Dynamic Science.
Availability: SAE

HS-018 276

DEVELOPMENT OF POLICE CAR BRAKE STANDARDS

In 1957, the Los Angeles Police Department recognized the need for improvement in braking systems on police emergency vehicles. From that date to the present time, there has been an ongoing program of testing and evaluating brake linings and braking systems to provide fade-free balanced braking. As a result of this program, substantial improvements have been made in developing brake characteristics which point the way for police vehicle braking standards. Tests were run on a

from the field. Representatives from each of the automobile manufacturers' brake engineering staffs were invited to participate in the tests. Several types of brake linings were sent from manufacturers participating in the testing program. It is anticipated that the utilization of a 4-wheel disc brake with a metallic or semimetallic pad on all four discs will probably meet the needs of police application.

by G. R. Wynne
Los Angeles Police Dept.
Rept. No. SAE-750397 ; 1975 ; 8p
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 277

A BRAKING EFFICIENCY TEST TECHNIQUE

A method whereby vehicle stopping performance can be specified, measured, and compared independently of the test surface is presented. It provides for an independent measure of the prevailing friction potential of the test surface which is used to normalize the measured stopping performance of the test vehicle. The concept presented is tailored toward a safety argument and toward rulemaking as a potential adaptation to braking effectiveness requirements which currently exist. A new mobile tire dynamometer, developed for this program, is discussed, as are the results of a demonstration test program. The computation of the ideal stopping distance is appended.

by Christopher B. Winkler; Robert D. Ervin
University of Michigan
Rept. No. SAE-750398 ; 1975 ; 15p 3refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 278

IS THE PROPOSED FEDERAL STANDARD FOR BRAKES ADEQUATE FOR POLICE PATROL VEHICLES?

In 1972, the National Bureau of Standards surveyed 530 police departments to determine what was wrong with their patrol cars: 449 departments responded to the survey. Thirty-two percent of the respondents identified brakes as the most dangerous feature, and 36 percent identified it as the system most in need of standards. Ninety-four percent of the respondents rated their patrol car brakes excellent to satisfactory at speeds under 70 mph but 25% rate them poor over 70 mph. While the new Federal Motor Vehicle Safety Standard 105-75 may improve the brake systems for patrol cars for routine, low speed use with frequent brake applications, it will be necessary to continue testing patrol car brakes under severe driving conditions to assure reliability at high speeds.

by Jared J. Collard
National Bureau of Standards
Rept. No. SAE-750399 ; 1975 ; 8p 6refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 279

RADIAL PLY TIRES--HOW DIFFERENT ARE THEY IN THE LOW LATERAL ACCELERATION REGIME

Cornering and camber stiffness for 160 passenger automobile tires were analyzed with the objective being to assess the differences between radial ply, bias belted, and bias ply tires in linear cornering properties. Radial ply tires could be clearly distinguished from bias belted and bias ply tires on the basis of their equivalent slip angles. Bias belted and bias ply tires, however, showed strong overlap in all their cornering data. A vehicle cornering at low lateral accelerations does not exhibit distinctly different under/oversteer characteristics with the three generic tire types as long as they are not mixed. If they are mixed, large departures from the matched state may occur, particularly for radial ply/bias ply tire configurations. Large changes may also take place if tires are replaced by others of the same generic type but of different brands.

by Dieter J. Schuring; R. Douglas Roland
Calspan Corp.; AMF, Inc.
Rept. No. SAE-750404 ; 1975 ; 18p 2refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 280

THE EFFECT OF BELT MATERIALS ON PERFORMANCE OF RADIAL PASSENGER TIRES

The effect of radial passenger tire performance of the four most common belt materials, fiberglass, Kevlar, rayon, and steel, is discussed in light of their contributions to tread band stiffness. The magnitude of the material effects on performance is compared to the magnitude of belt geometric design effects on performance. Performance variables discussed include: high speed; power loss; wear; harshness; and force and moment. It is demonstrated that the belt material differences do have a significant effect on performance related directly to how the material differences affect tread band stiffness. It is also shown that other design effects can overwhelm differences due to material differences alone.

by Marion G. Pottinger
B. F. Goodrich Co.
Rept. No. SAE-750405 ; 1975 ; 12p 23refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 281

TIRE INDUCED STEERING PULL

A theory of vehicle steering pull, created by asymmetrical tire cornering properties, is developed. It is validated with free control data obtained on the road. The effects of tire lateral force and aligning torque asymmetries on a car's straight line stability are analyzed for both fixed and free control. Equations for front axle lateral force, steering system moment, and sideslip angle are derived. These are based on tire properties and certain assumptions about the automobile's characteristics. This theory is validated using data obtained in open road testing. The test techniques, as well as alternate ones, are presented in addition to the relationships between actual front axle force and axle concavity force, ply steer force, and lateral

force offset. It was found that front axle conicity force correlates very strongly with a more accurate theoretical prediction. Axle force predicted by tire conicity force is somewhat low.

by Richard W. Topping
B. F. Goodrich Co.
Rept. No. SAE-750406 ; 1975 ; 10p 5refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 282

MASS DISTRIBUTION PROPERTIES OF THE MALE CADAVER

Mass distribution properties of the human body and its 14 primary segments were measured in three dimensions using six male cadavers. Data collected include anthropometry, mass, center of mass, and the principal moments of inertia. The principal moments of inertia were computed using a 3 x 3 matrix of values derived from simple pendulum measurements about six non-parallel axes. Anatomical segmentation procedures used are emphasized and compared with those in previous investigations. In addition, comparisons of the measured data with the extant data in the literature on the whole body and its segments are presented and discussed. It is concluded that: the relationships of the segment principal moments of inertia to body mass and segment volumes are high with the latter providing, in general, the best predictors of inertia; the directional angles of the principal moments tend to approximate but are not identical to the segment-reference axis system; and for most segments, the difference in the principal moments-of-inertia between the seated and standing subjects are small and fall within sample variability.

by Herbert H. Reynolds; Charles E. Clauser; John McConville; Richard Chandler; J. W. Young
Hwy. Safety Res. Inst.; Wright-Patterson Air Force Base;
Webb Associates; Civil Aeromedical Inst., FAA
Rept. No. SAE-750424 ; 1975 ; 21p 28refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 283

ANTHROPOMETRIC BASIS OF THE GM ATD 502 CRASH TEST DUMMY

An anthropometric basis for crash dummy design, resulting in the development of the General Motors Anthropometric Test Dummy 502, is described. The spinal column of an average adult male was located for an erect seated position leading to guidelines for placement of dummy components and sectioning of the dummy into segments. The demarcation scheme for dummy segments with a known correspondence to human structure is defined. The weight and weight distribution of these dummy segments were defined, based on anthropometric data. These results provide some assurance that the size, relative location, and weight distribution of dummy structures are representative of human characteristics. The following work is recommended: definition of the location of human body structures in a range of automotive seats with particular emphasis on the location of the head, chest and pelvis; definition of the configuration of human shoulders, chest and pelvis; and

large and small male and female adults based on a rational sizing scheme.

by Robert P. Hubbard
General Motors Res. Labs.
Rept. No. SAE-750429 ; 1975 ; 7p 8refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 284

DYNAMIC ANTHROPOMETRY AND DESIGN OF A VEHICLE DRIVER'S CONTROL AREA

An automobile driver's control area must be designed in such a way as to comply with morphological and biomechanical requirements in order to make it possible for the driver to get the best advantage of the area. Problems encountered in the achievement of the driver's control area are of different kinds: dimensional analysis of the space used by the driver and relative motions of anatomical elements; and performance variability analysis in relation to control position within the defined activity space. Such an analysis can only bring about results if it takes into account a fundamental factor of material and equipment design--the development of morphological features of the using population. Two observations were made from an analysis of performance variation: that subjects instinctively and almost always without any noticeable variation, recover the postures which they had adopted during previous experiments; and the functional area drawn by the prominent limb proved different and generally larger than that drawn by the other upper limb. This raises the problem of prominent limb functional activity in a minority population of left-handed people living in an environment designed and used by a majority of right-handers.

by A. Colbentz; G. Ignazi
Laboratoire d'Anthropologie et d'Ecologie Humaine (France)
Rept. No. SAE-750430 ; 1975 ; 6p
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 285

ROUGHNESS IN STEEL-BELTED RADIAL TIRES--MEASUREMENT AND ANALYSIS

The roughness performance of sixteen steel-belted radial tires has been studied using high speed uniformity, subjective evaluations, and instrumented vehicle techniques. An analysis of the results indicates two important conclusions. First, the tractive force variation is the principal tire non-uniformity causing steel-belted radial tire roughness in a majority of 1973 vehicles. This conclusion is based on two experimentally verified facts: that resonant frequencies of steel-belted radial tires are independent of manufacturer, with the first resonant mode of tractive force variation occurring at 28 Hz.; and that the majority of 1973 vehicles exhibit primary transfer function resonances between 20-40 Hz. Since the fore-aft resonant frequency of the tire coincides with the fore-aft transfer function resonance of the vehicle, a large percentage of the tractive force variation energy from the tire can be transmitted to the vehicle, thereby resulting in a tire roughness disturbance. The second result of the analysis indicates that accurate cor-

strumentation readings, and that these values also correlate well with outdoor ride analysis.

by K. D. Marshall; N. W. St. John
B. F. Goodrich Co.
Rept. No. SAE-750456 ; 1975 ; 8p 2refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 286

THERMAL/VOLTAGE RESPONSE CHARACTERISTICS OF AUTOMOTIVE NONANTIMONIAL LEAD-ACID BATTERIES

The critical temperature/voltage relationship for initiation of thermal runaway is characterized for standard antimonial, low antimonial, and nonantimonial automotive lead-acid batteries. Current acceptance under overcharge conditions over the full range of normal operating temperatures and applied voltages revealed the following advantages for eliminating antimony from the lead-acid battery: better tolerance of high temperatures and overvoltages resulting in an associated lower rate of positive grid corrosion; a reduction in the rate of water loss, and a reduction in the rate of generation of explosive gas mixtures; and 20-25 percent higher cranking currents. Problems such as substantial manufacturing costs, voltage regulation malfunction, and lack of any practical antimony free alloys at the present, are likely to retard wide usage of antimony free batteries until further advances are made in technology.

by Charles E. Wright; Vincent M. Halsall
Globe-Union Inc., Globe Battery Div.
Rept. No. SAE-750471 ; 1975 ; 4p 3refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 287

BEAD CONTACT PRESSURE MEASUREMENTS AT THE TIRE-RIM INTERFACE

A method for measuring the normal contact pressure distribution at the interface between a tire and a rim using a miniature magnetostrictive transducer as the load sensor is described. The transducer is a 0.050 inch diameter nickel ferrite toroidal core wrapped with primary (excitation) and secondary (sense) windings. As the core is stressed, the magnetostrictive phenomenon causes an increase in the magnetic flux and a corresponding change in the induced output voltage across the sense windings. This voltage change is signal conditioned to yield a direct current voltage output as a function of core stress which is proportional to the bead contact pressure. The bead contact pressures were mapped at the interface between various radial tires and rims under static and dynamic loading conditions. Static pressure distributions obtained for the inflated, but otherwise unloaded, condition provide a measure of the conformability of the tire to the rim. Dynamic pressure distributions show stress patterns developed under straight-ahead rolling and cornering conditions. With the aid of such bead contact pressure measurements, stress analysis studies of tires and wheels can now be conducted on a more rational basis than in the past because the exact nature of the load dis-

tribution at the tire-rim interface is known for various tire loading conditions.

by J. D. Walter; R. K. Kiminecz
Firestone Tire and Rubber Co.; Systems Res. Labs.
Rept. No. SAE-750458 ; 1975 ; 10p 9refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 288

AN OPTICAL CORRELATION METHOD FOR THE DIRECT MEASUREMENT OF TRANSIENT SIDESLIP AND SLIP ANGLES OF MOTOR VEHICLES [EIN KORRELATIONSOPTISCHES VERFAHREN ZUR DIREKTEN MESSUNG VON INSTATIONAREN SCHWIMM- UND SCHRAGLAUFWINKEIN AN KRAFTFAHRZEUGEN]

A method which enables the direct measurement of sideslip and slip angles, even under transient driving conditions, is presented. The method is based on the principle of non-contact velocity measurement at the vehicle in two coordinates: the two measured velocity vectors; and the instantaneous direction of motion. Thus, the sideslip and slip angles can be determined. High demands are made on the measuring accuracy, since angles of less than one degree frequently occur. The velocity sensors, developed by the Leitz Company, operate according to an optical correlation method with spatial frequency filtering, in which the road surface structure is reproduced on a grating, and the passing light is collected by a photo recorder. The photo recorder signal frequency is proportional to the velocity with which the image planes are moved normal to the grating lines. Numerous measurements under various driving conditions established that the instrument satisfies the demands with respect to accuracy, handiness, and universal implementation in the vehicle, and is superior to former methods of measuring slip angles. With this method, one of the gaps in vehicle measuring technique has been closed.

by Adam Zomotor
Publ: ATZ Automobiltechnische Zeitschrift v77 n7/8 p213-8
(Jul/Aug 1975)
1975 ; 13refs
Text also in German.
Availability: See publication

HS-018 290

MONTHLY VARIATIONS IN ROAD ACCIDENT FREQUENCY

The seasonal variation of accident numbers and traffic volumes in Britain are described, the variation in these patterns over the past few years is investigated, and trends in the seasonal variation of traffic fatalities in Britain and the United States (U.S.) since 1956 are compared. The British accident data used were the numbers of all injury accidents reported to British police in the years 1965-1973. The percentages of the annual accident totals occurring in each month of these years are tabulated. The British and American fatality data between 1956 and 1973 are not fully tabulated. It is concluded that: the distribution of traffic volumes, accidents and fatalities in

opposite direction.

by S. P. Satterthwaite

Publ: Traffic Engineering and Control v17 n1 p18-20 (Jan 1976)
1976 ; 8refs

Availability: See publication

HS-018 291

THE EVALUATION OF THE NORTH CAROLINA K-9 TRAFFIC SAFETY CURRICULUM

A pilot traffic safety curriculum for use in kindergarten through the ninth grades was implemented in fourteen public schools in North Carolina. The Highway Safety Research Center conducted an evaluation of the curriculum in three phases: the amount of knowledge that students acquired was measured by tests administered before and after the curriculum was taught; the extent to which the children modified their pedestrian and bicyclist behavior was examined; and a questionnaire was mailed to each teacher participating in the curriculum in order to determine how useful the materials were, how much they were used, and what changes were recommended. Evaluation showed that the curriculum was generally well accepted and used by the teachers. At the elementary school level, the curriculum resulted in a significant increase in students' traffic safety knowledge, but behavioral changes were not observed to reflect this increased knowledge. The major reason given for not teaching an area of the curriculum was inadequate time. The independent judgments of pedestrian and bicyclist behavior are tabulated and copies of the questionnaires used are provided.

by Susan S. Padgett; Patricia F. Waller
University of North Carolina, Hwy. Safety Res. Center,
Chapel Hill, N.C.
1975 ; 80p

Supported by the State of North Carolina in cooperation with the National Hwy. Traffic Safety Administration and the Res. Triangle Inst.

Availability: Corporate author

HS-018 292

THE NATIONAL ELECTRONIC INJURY SURVEILLANCE SYSTEM AND BICYCLE- ASSOCIATED ACCIDENTS: FINAL REPORT

The National Electronic Injury Surveillance System (NEISS) used by the Consumer Products Safety Commission (CPSC) has produced data which lead to national estimates of product-associated injuries. The results of a study of the methods of data collection used by the NEISS and the uses made of such data are presented. Two major areas for improvement of the NEISS are suggested: changing the design of the hospital sample and instituting primary data collection rather than sampling existing hospital records. Product comparisons implied by the "age adjusted frequency severity index" calculated by the CPSC are found to be quite sensitive to the particular injury severity scale used and to the particular age weighting factor used. Alternatives to the numerical scales currently used are suggested. An analysis of bicycle-associated injuries based on data from the NEISS is presented which shows a nearly stable total after adjustment for seasonal effects. Misinterpretations of the data which have appeared in various publications are

presented.

by Jairus D. Flora; Richard J. Kaplan; Elizabeth Margoshes;
Peter D. Ward
University of Michigan, Hwy. Safety Res. Inst., Ann Arbor,
Mich.

Rept. No. UM-HSRI-SA-75-18 ; 1975 ; 156p 19refs
Sponsored by the Bicycle Manufacturers Assoc. See also
Interim rept. HS-018 213.

Availability: Corporate author

HS-018 293

INVESTIGATION INTO THE DEGREE OF APPLICATION OF THE FREQUENCY PARAMETER AT PART THROTTLE CONDITION IN GASOLINE ENGINES

An application of the frequency parameter for viscous flow air meters to the measurement of air consumption of gasoline engines at full-and part-throttle conditions is investigated. Experiments with a single cylinder engine have shown that at higher engine speeds, the linear relationship between the ratio of flow and the pressure difference deviates. Therefore, the frequency parameter obtained at deviation speeds for each viscous flow meter can be used as a criterion for the dependable working range. As a result, an exponential relationship has been found between the frequency parameter and the plenum distance of the viscous flow air meter. According to this relationship, it is clear that the dependable working range of the viscous flow meters increases when applied to the engine running in part-throttle condition. In all 16 tests performed, the flow rates were measured by using an orifice meter together with an air box under a steady flow condition. Then the value of the flow rates were plotted versus the pressure difference across the viscous flow air meter for each test. The results showed that the volume rate of flow versus the mean pressure drop across the viscous flow air meter remained linear up to a certain range. Beyond the range, the relationship deviated from linearity as the speed increased.

by H. Sezgen
Middle East Technical Univ. (Turkey)
Rept. No. SAE-750474 ; 1975 ; 16p 11refs
Presented at the Automotive Engineering Congress and
Exposition, Detroit, Mich., 24-28 Feb 1975.
Availability: SAE

HS-018 294

SOME CHARACTERISTICS OF LIGHT-TRUCK ACCIDENTS IN TEXAS. FINAL REPORT

Highway Safety Research Institute (HSRI) maintained data for police-reported accidents in the state of Texas during calendar year 1973. Data were studied to establish some characteristics of light-truck accident involvements and to compare the accident experience of passenger cars and light trucks. Findings were presented in terms of weather, type of truck, injury frequency and severity, driver-related factors, roadway configuration, time of day, and day of week. It was found that light-truck accidents are most likely to occur during the daytime on weekdays, especially on Friday. The majority of accidents occur in cities or on trunkline highways on straight level roads that are in good condition. Collision with another motor vehicle was the most frequent type of accident. Occu-

passenger-car occupants. Drivers of light trucks tend to be older than drivers of automobiles, and they are predominately male. Distribution of police-reported violations is much the same as for passenger cars, with failure to yield right of way the most frequently occurring type of violation.

by John A. Green
University of Michigan, Hwy. Safety Res. Inst., Ann Arbor, Mich. 48105
Rept. No. UM-HSRI-SA-75-15; 1976; 39p 2refs
Report for Jun-Jul 1975. Sponsored by the Motor Vehicle Manufacturers Assoc.
Availability: Motor Vehicle Manufacturers Assoc., 320 New Center Blvd., Detroit, Mich. 48202

HS-018 295

REFLECTORIZED LICENSE PLATES: A REVIEW AND ANALYSIS OF RESEARCH, TECHNICAL DATA AND DOCUMENTATION RELATED TO THEIR USE

A report on the use of reflectORIZED license plates by a number of states is presented. Factors resulting from the use of reflectORIZED plates are analyzed. Among these factors are: visual factors such as detection and recognition of plates by other drivers and law enforcement officials; clarification of traffic status; accidents and visibility by state; engineering and use considerations; economics; durability of reflectORIZED plates; and decision making about the use of reflectORIZED plates. A special survey was made of rear-end and nighttime collisions involving the license plates; rural traffic accidents; mean reflectivity of various types of plates; and projected costs savings assuming all vehicles were reflectORIZED versus all vehicles were not reflectORIZED. In summary, it was reported that: reflectORIZED plates increase the probability that the vehicle will be detected sooner by an approaching vehicle; some impressive decreases in night collisions were obtained by use of the plates in certain states; the reflectORIZED plate provided a durable visibility aid that could be periodically renewed; legibility of reflectORIZED plates was better than non-reflectORIZED plates in law enforcement/vehicle identification; and the use of the reflectORIZED plates was cost-beneficial in use on state-owned vehicles. Analyses also show that the plate has benefits in assessing cars with portions of the lighting system not functioning, providing detection distances in excess of stopping distances, supplying reflectORIZATION on the front of the vehicle, and aiding judgment of distances.

by Kenneth G. Cook
Century Res. Corp., 4113 Lee Hwy., Arlington, Va. 22207
1975; 111p 130refs
Sponsored by 3M Co., Safety Systems Dept., St. Paul, Minn. 55101.
Availability: 3M Co., Safety Systems Dept., St. Paul, Minn., 55101

HS-018 296

CADILLAC'S ELECTRONIC FUEL INJECTION

Cadillac Motor Car Division of General Motors has introduced an electronic fuel-injected Seville as standard-equipment. This marks the first standard-equipment application of fuel injection to an American automobile. Fuel injection offers basic advantages such as: elimination of the manifold heat riser and carburetor choke; elimination of the need to design intake manifolds with consideration of the effects of hot spots or fuel

to fast braking or cornering; freedom in styling of hood lines; and capability to deliver an identical air-fuel charge to each of the cylinders, which permits the engine to operate closer to its lean limit and still provide good drivability. Disadvantages include: increased cost over conventional carburetion; increased elaboration and complication of components; and the need to re-educate service personnel to deal with the new, complex system.

by Larry Givens
Publ: Automotive Engineering v84 n2 p18-23 (Feb 1976)
1976

Prepared in cooperation with General Motors Corp., Cadillac Motor Car Div., and Bendix Corp., Electronics and Engine Control Systems Group.
Availability: See publication

HS-018 297

NEW CONCEPTS IN IGNITION TECHNOLOGY

A multiple-firing ferroresonant capacitive-discharge ignition (FCDI) system with sustained discharge between successive firings, recently designed by Ford Motor Co.'s engineering and research staff, is described. The FCDI is a programmable system in which spark characteristics such as duration, restriking rate, gap current, and gap energy can be electronically controlled. The operation depends on an ignition coil equipped with a ferroresonant secondary circuit. This differs from conventional resonance in the following ways: it exhibits hysteresis characteristics; its resonant frequency depends on its voltage level; and the ferroresonance tends to be more broad banded than conventional resonance. The coil contains a dual primary winding; a single secondary winding; and a ferrite core. A small number of three-gap spark plugs were fabricated for experimental analysis and it was found that they not only provide substantially longer arc lengths, but allow for more dissipation of the energy stored in the winding of the ignition coil. Energy is delivered in a shorter time, and the breakdown voltage required to establish the long arc length can be made significantly less than that for a single-gap plug.

Publ: Automotive Engineering v84 n2 p26-9 (Feb 1976)
1976

Based on SAE papers 760264, "The Performance of a Multigap Spark Plug Designed for Automotive Applications" and 760266, "The Ferroresonant Capacitor Discharge Ignition (FCDI) System: a Multiple Firing CD Ignition with Spark Discharge Sustaining Between Firings," presented at the SAE Annual Meeting, Detroit, 23-27 Feb.
Availability: See publication

HS-801 494

MULTIDISCIPLINARY ACCIDENT INVESTIGATION SUMMARIES. VOL. 6, NO. 8

Case summaries of recent in-depth reports submitted by Multidisciplinary Accident Investigation Teams are given. The case reports are individual, clinical studies of accidents which generally involve vehicles of the last three model years in fatal, injury producing, or property damage severity (involving at least one vehicle being towed from the scene) accidents. In investigating the accident, the team members made an in-depth study of each level of the collision (pre-crash, crash, and post-crash) and each element of the collision (human, vehicle, environment). Each summary consists of identification informa-

HS-801 499

tion; basic information on the highway and vehicles involved; a description of the driver and occupants involved (with their injuries); a phase-by-phase description of the sequence of events of the collision; and a list of the causal factors, conclusions and recommendations. A diagram of each collision is given on the last page of each summary. Reports in this collection were taken from the files of: Calspan Corporation; University of Michigan; University of Oklahoma; Stanford Research Institute; University of Southern California; and the University of Utah.

National Hwy. Traffic Safety Administration, 400 Seventh St., S.W., Washington, D.C. 20590
Rept. No. PB-241 647 ; 1975 ; 354p
Availability: NTIS

HS-801 499

MULTIDISCIPLINARY ACCIDENT INVESTIGATION SUMMARIES. VOL. 6, NO. 5

Case summaries of in-depth reports submitted by the Multidisciplinary Accident Investigation Teams are presented. The case reports are individual, clinical studies of accidents which generally involve vehicles of the last three model years in fatal, injury producing, or severe property damage (involving at least one vehicle being towed from the scene) accidents. In investigating the accident, the team members made an in-depth study of each phase of the collision (pre-crash, crash, and post-crash) and each element of the collision (human, vehicle, and environment). Each summary consists of identification information; basic information on the highway and vehicles involved; a description of the driver and occupants involved (and their injuries); a phase-by-phase description of the sequence of events of the collision; and a list of the causal factors, conclusions and recommendations. A diagram of each collision is given on the last page of each summary. Reports in this collection were taken from the files of: Calspan; Maryland Medical-Legal Foundation; University of Michigan; University of Oklahoma; Stanford Research Institute; and the University of Utah.

National Hwy. Traffic Safety Administration, 400 Seventh St., S.W., Washington, D.C. 20590
Rept. No. PB-241 644 ; 1975 ; 344p
Availability: NTIS, PB-241-644

HS-801 501

MULTIDISCIPLINARY ACCIDENT INVESTIGATION SUMMARIES. VOL. 6, NO. 4

Case summaries of in-depth reports submitted by the Multidisciplinary Accident Investigation Teams are presented. The case reports are individual, clinical studies of accidents which generally involve vehicles of the last three model years in fatal, injury producing, or severe property damage (involving at least one vehicle being towed from the scene) accidents. In investigating the accident, the team members made an in-depth study of each phase of the collision (pre-crash, crash, and post-crash) and each element of the collision (human, vehicle, and environment). Each summary consists of identification information; basic information on the highway and vehicles involved; a description of the driver and occupants involved (and their injuries); a phase-by-phase description of the sequence of events of the collision; and a list of the causal factors, conclusions and recommendations. A diagram of each

collision is given on the last page of each summary. Reports in this collection were taken from the files of: Calspan; Maryland Medical-Legal Foundation; Southwest Research Institute; Stanford Research Institute; and the University of Utah.

National Hwy. Traffic Safety Administration, 400 Seventh St., S.W., Washington, D.C. 20590
Rept. No. PB-241 643 ; 1975 ; 341p
Availability: NTIS, PB-241-643

HS-801 775

MOTOR VEHICLE SAFETY DEFECT RECALL CAMPAIGNS. JULY 1, 1975 TO SEPTEMBER 30, 1975. DETAILED REPORTS. QUARTERLY REPORT

A detailed information collection regarding defect recall campaigns conducted by domestic and foreign automobile equipment manufacturers during the third quarter of 1975 is presented. Domestic companies covered in the survey included: AM General Corporation; Blue Bird Body Company; Boyertown Auto Body Works; Bricklin Vehicle Corporation; Brougham Industries; Champion Home Builders Company; Checker Motors Corporation; Chrysler Corporation; Executive Industries, Incorporated; Fleetwood Enterprises, Incorporated; The Flexible Company; Ford Motor Company; General Motors Corporation; Harley-Davidson Motor Company; International Harvester Company; J. H. Holland Company; Lockheed Missiles and Space Company; Mack Trucks; Paccar, Incorporated; Sebring-Vanguard, Incorporated; Sheller-Globe Corporation; Starcraft Company; Sutphen Fire Equipment Company; Symons Corporation; Vesely Company; Welch Fire Equipment Company; White Motor Corporation; and Wheelabrator Industries. Foreign automobile manufacturers included: British Leyland Motors; Fiat Motor Company; Jensen Motors; Kawasaki Motors; Norton Triumph Corporation; Porsche/Audi, Incorporated; and Yamaha International Corporation. Equipment manufacturers include: B. F. Goodrich Tire, and Engineered Systems Company; Cummins Engine Company; General Tire and Rubber Company; Geneva Metal Works Company; Goodyear Tire and Rubber Company; Kelly-Springfield Tire Company/Aluminum Company of America; Kelsey-Hayes Company; Montgomery Ward and Company; Rockwell International; and Sealco Air Controls, Incorporated.

National Hwy. Traffic Safety Administration, Washington, D.C. 20590
1975 ; 565p

Cover title: Motor Vehicle Safety Defect Recall Campaigns--Detailed Reports from July 1 to September 30, 1975.
Availability: NTIS

HS-801 779

SYMPOSIUM ON EFFECTIVE HIGHWAY SAFETY ADJUDICATION. VOL. 1. FINAL REPORT

A symposium was held to explore ways to make traffic offense adjudication more highway safety effective. Sixteen highway officials from 10 primarily eastern states, as well as national experts, were in attendance. The symposium explored the relationship between traffic violations and highway accidents; the advisability of implementing administrative hearings to supplement or replace traffic court adjudication; the need for change in the traffic law system; improved rehabilitation techniques for problem drivers; and innovative approaches in handling problem drinker drivers. State discus-

groups focused on critical driver control problem areas and developed remedial plans of action. It was recognized that traffic law and adjudication aspects of highway safety require renewed attention. There is a need for research and innovation, and legislation should be enacted to allow experimentation in improved traffic case disposition methods and additional symposia conducted for wide dissemination of traffic law/adjudication/highway safety material.

University of Denver Coll. of Law, 200 West 14th Ave., Denver, Colo. 80204
Contract DOT-HS-249-3-704
1975; 55p
Symposium held in New York City, N.Y., 13-16 Nov 1973. Report for Aug 1973-Feb 1975. Cover title: Report on Symposium on Effective Highway Safety Adjudication. Vol. 1. Vol. 2 is HS-801 780.
Availability: NTIS

HS-801 780

SYMPOSIUM ON EFFECTIVE HIGHWAY SAFETY ADJUDICATION. VOL. 2. FINAL REPORT

A symposium was held to explore ways to make traffic offense adjudication more highway safety effective. This report is a collection of the presentations held at the symposium, questions from the audience, pre-and post-symposium questionnaires, discussion group materials, and summaries of state discussion sessions. Topics in presentation included: highway safety adjudication, overview and orientation; highway traffic safety system overview; the relation of the highway to traffic safety; a task force report; a research report; perspectives on "problem" drivers and programs to improve them; a systematic approach to the control of the drinking driver; two research reports on the characteristics of the drinking driver; political and economic barriers to change in highway safety and accident prevention; and legal issues in traffic offense adjudication. The report also shows new trends and highlights in administrative and judicial adjudication of traffic offenses and classification of traffic offenses as infractions, recent U.S. Supreme Court decisions affecting traffic safety court adjudication, a symposium opinion survey, and a list of the attendees.

University of Denver Coll. of Law, 200 West 14th Ave., Denver, Colo. 80204
Contract DOT-HS-249-3-704
1975; 215p refs
Symposium held in New York City, N.Y., 13-16 Nov 1973. Report for Aug 1973-Feb 1975. Cover title: Report on Symposium on Effective Highway Safety Adjudication. Vol. 2. Vol. 1 is HS-801 779.
Availability: NTIS

HS-801 788

CHILD RESTRAINT LATERAL IMPACT TESTS. FINAL REPORT

A series of six 20 mph 60° lateral impact tests with various child restraints were conducted to provide a brief overview of the state-of-the-art in lateral protection of child restraints which have been developed through dynamic testing. Tests were performed on an impact sled utilizing a standard vehicle seat with safety belts with no retractors or reels. Two test dummies were used; an Alderson VIP-3C child dummy and a

of the six tests. Ten child restraint systems were tested and instrumentation included a film camera, a sled mounted accelerometer, four belt load cells, and discrete magnetic proximity probes for sled velocity determination. Full test results are reported in terms of dummy target motion with time, anchorage belt loads versus time, sequence camera coverage and a brief narrative evaluation of the performance of each system. Photographs of the tests are provided.

by J. W. Melvin
University of Michigan, Hwy. Safety Res. Inst., Ann Arbor, Mich. 48109
Contract NHTSA-6-5180
Rept. No. UM-HSRI-BI-75-7; 1976; 92p
Report for 1 Sep-1 Oct 1975.
Availability: NTIS

HS-801 789

DEVELOPMENT OF AN AIR BAG-CRUSHABLE DASH-KNEE BAR PASSIVE RESTRAINT SYSTEM FOR SMALL CARS. FINAL TECHNICAL REPORT

A study was conducted to design, fabricate, test, and evaluate a front passenger passive restraint system which would provide occupant protection under small car high speed frontal impact crash conditions. The restraint developed employs an air bag, a crushable dash panel, and a knee bar. The full test program consisted of: 18 developmental sled test runs; 39 evaluation sled test runs; two full scale crash tests into a flat barrier with two modified Ford Pintos at 41.5 and 41.7 mph; 19 post evaluation runs; energy absorbing steering column tests; and final configuration tests. Results indicate that the restraint system developed appears capable of providing protection from fatality or serious injury to adult size occupants in a small car environment up through the 35 to 40 mph crash speed range. The system without the air bag can provide adult protection up to the 25 to 30 mph speed range. It is also indicated that the system provides protection through the 35 to 40 mph speed range for the normally seated child and will not injure a forward position child during deployment, the deployment problem being resolved through bag folding technique.

by David J. Romeo
Calspan Corp., 4455 Genesee St., Buffalo, N.Y. 14221
Contract DOT-HS-4-00972
Rept. No. ZM-5566-V-1; 1976; 101p 5refs
Report for Jun 1974-Dec 1975. For summary report, see HS-801 819.
Availability: NTIS

HS-801 792

SYSTEMS ANALYSIS OF ALCOHOL COUNTERMEASURES. FINAL TECHNICAL REPORT

A benefit/cost analysis of the following alcohol safety countermeasures was conducted in order to determine the potential for successful implementation in terms of the estimated cost/effectiveness of each countermeasure and to provide the National Highway Traffic Safety Administration with baseline information for allocating research money in countermeasure development: sober pill; self tester; evidential roadside tester; non-cooperative breath tester; alcohol safety interlock system; continuous monitoring device; and operating time recorder. Effectiveness was measured in terms of alcohol-related accident reduction, while cost was defined as the cost of developing

found that each countermeasure would be cost/effective if certain technological, performance, and cost conditions are met. These conditions are clearly stated for each countermeasure.

by William S. Moore; Jose F. Imperial; Joan Tunstall; Marvin H. Wagner; Paul M. Hurst
General Res. Corp., Westgate Res. Park, McLean, Va. 22101
Contract DOT-HS-4-00995
Rept. No. OAD-CR-115 ; 1976 ; 190p 21refs
Report for Jul 1974-Jul 1975.
Availability: NTIS

HS-801 796

RAPID RESPONSE SYSTEM TO GENERATE HIGHWAY CRASH DATA. FINAL REPORT

A study was conducted to design, test, and document a system which can rapidly provide specified highway crash data responsive to the needs of the National Highway Traffic Safety Administration. The topic selected for field testing was the impact of the seat belt-ignition interlock on restraint usage. Data were collected in Pennsylvania during four separate periods between November 1973 and January 1975. A total of 872 cases of accident-involved 1974 model passenger cars were studied. Another 876 cases of accident-involved 1973 models were also analyzed for comparison purposes. It is concluded that: the case acquisition rate during the initial collection period was considerably lower than anticipated; one on-site clerk was required for each data collection period; investigating officers were frequently unable to obtain specific methods by which the interlock system had been defeated; some initial confusion on the part of the investigating officers about how to fill out the supplemental forms was evident; another aspect of the time lags in communicating with field collection personnel involved supplemental forms which could not be processed due to contradictory data; and the procedures designed for the system are predicated on the activation of an already-existing data collection and analysis network. Data tables and collection forms, police directives, and tally sheets are appended.

Indiana Univ., Inst. for Res. in Public Safety, 400 East Seventh St., Bloomington, Ind. 47401
Contract DOT-HS-034-2-410
Rept. No. DOT-HS-034-2-410-75-RR5 ; 1976 ; 75p 3refs
Report for 1 Jun 1972-15 Mar 1975.
Availability: NTIS

HS-801 797

REVIEW OF STATE AND COMMUNITY HIGHWAY ALCOHOL SAFETY PROJECTS: A STUDY OF THE STIMULUS EFFECT OF NHTSA ALCOHOL SAFETY PROGRAMS. VOL. 1. FINAL REPORT

A study was conducted to determine the stimulus effect and impact of the Alcohol Safety Action Projects (ASAP) and other federal alcohol safety programs on state and community projects, to devise a project classification system, and to gather information helpful in providing guidance to projects. Self-administered questionnaires were returned by a sample of state governor's offices and project directors throughout the country. Exemplary projects were identified and sites visited. Findings show that the ASAP program stimulates the initiation and success of projects and activities directed at the drinking and driving problem, and that funding problems are a major obstacle to the initiation and continuation of projects. Project

effectiveness is not affected by staffing configuration or part or full-time roles. Factors important for project effectiveness include: prior ASAP experience of staff; coordination of each countermeasure area; referral of drunk driving offenders to educational and treatment courses; use of mass media for safety publicity; selective enforcement efforts and special patrols; certified operators on duty 24 hours a day all year; judicial seminars; recommendation to judges regarding treatment; identification and utilization of local resources; a year's probation for convicted drunk drivers; evaluation after treatment; and the use of advisory committees.

Planning and Human Systems, Inc., 3301 New Mexico Ave., N.W., Washington, D.C. 20016
Contract DOT-HS-4-00939
1976 ; 30p
Report for Jun 1974-Nov 1975.
Availability: NTIS

HS-801 798

REVIEW OF STATE AND COMMUNITY HIGHWAY ALCOHOL SAFETY PROJECTS: A STUDY OF THE STIMULUS EFFECT OF NHTSA ALCOHOL SAFETY PROGRAMS. VOL. 2. FINAL REPORT

A study was conducted to determine the stimulus effect and impact of the Alcohol Safety Action Project (ASAP) and other federal alcohol safety programs on state and community projects, to devise a project classification system, and to gather information helpful in providing guidance to projects. Self-administered questionnaires were returned by a sample of state governor's offices and project directors throughout the country. Exemplary projects were identified and sites visited. Reports of all 15 sites visited are presented: general site characteristics; program initiation and development; overview of the project; future prospects and plans; and countermeasures. Persons interviewed in on-site visits and state and community alcohol programs are listed. Copies of the questionnaires sent to the governors and the project directors and the personal interview form used at the site visits are also provided.

Planning and Human Systems, Inc., 3301 New Mexico Ave., N.W., Washington, D.C. 20016
Contract DOT-HS-4-00939
1976 ; 30p
Report for June 1974-Nov 1975. Vol. 1 is HS-801 797.
Availability: NTIS

HS-801 799

MULTIDISCIPLINARY ACCIDENT INVESTIGATION. OKLAHOMA. FINAL REPORT

A multidisciplinary investigation of all vehicle traffic accidents from which a fatality occurred within 24 hours in two Oklahoma cities with comparable population composition was carried out. One of the cities (Oklahoma City) had an active Alcohol Safety Action Project (ASAP) while the other (Tulsa) did not. Data on fatal accidents were gathered in five separate categories: in Oklahoma City, responsible driver in alcohol related fatal accidents, responsible driver in nonalcohol related fatal accidents, and nonresponsible driver in alcohol related and nonalcohol related fatal accidents; in Tulsa, responsible driver in alcohol related fatal accidents, and responsible driver in nonalcohol related fatal accidents. It was concluded that

although there was no difference between the two cities in total percentage of alcohol related fatal accidents, there were enough other indicators to conclude that the ASAP program was having a direct beneficial effect. An increased data base, the development of mechanisms to detect nonvisible defects in the driving public, and a different definition for a fatality are recommended. Detailed tables of driver/accident data, forms for recording environmental, vehicle, medical/injury, basic demographic, and interview summary data, maps of accident locations, and ASAP countermeasure descriptions are appended.

by R. A. Mill; M. L. Williams; J. L. Purswell; H. Beaulieu
University of Oklahoma, Center for Safety Res., Oklahoma City, Okla. 73104

Contract DOT-HS-219-3-708

Rept. No. OK-73 ; 1976 ; 124p 1ref

Report for 1 Sep 1973-30 Nov 1974.

Availability: NTIS

HS-801 800

MATHEMATICAL MODEL OF FOUR-WHEELED VEHICLE FOR HYBRID COMPUTER VEHICLE HANDLING PROGRAM

The mathematical model of a four-wheeled vehicle is documented. Particular attention is given to the derivation of the equations of motion of the sprung and unsprung masses and their subsequent modifications and revisions during the simulation development. Also discussed are: resultant forces and moments; suspension forces; wheel orientation and velocities; wheel rotational system; steering system; tire forces and moments; and vehicle orientation and position. The requirements for the definition of the vehicle parametric data are included. Experimental or analytical methods are discussed to determine various mechanical properties of vehicles: mass and inertia properties; front suspension; rear suspension; wheel rotational system; steering system; and tire properties. Procedures are described to transform the measured data into the form of the required parameter.

by Frederick Jindra
Ultrasystems, Inc., Dynamic Science Div., 1850 West Pinnacle Peak Rd., Phoenix, Ariz. 85027

Contract DOT-HS-4-00853

Rept. No. 8256-75-167 ; 1976 ; 201p 31refs

Report for Mar 1974-Oct 1975.

Availability: NTIS

HS-801 801

OCCUPANT SURVIVABILITY IN LATERAL COLLISIONS. VOL. 1. FINAL TECHNICAL REPORT

A study was conducted to investigate the feasibility of modifications to the vehicle interior and glazing which, when combined with structural modifications to upgrade compartment integrity, will allow occupants to survive severe accidents in lateral collision modes in a completely passive manner. Lateral impact testing involved two 1973 4300 pound Fords at speeds of 0 and 30 mph, 30 and 30 mph, and 0 and 40 mph, in collisions at 30, 45, 60, and 90 degree angles. Fiftieth percentile

accelerometers. Developmental testing of advanced interior padding and glazing materials and the fabrication of vehicles incorporating modified structures, interiors and side glazing are discussed. Lateral collision tests were performed with the modified vehicles. Results indicate that the greatest deficiency of conventional automobiles relative to lateral impact protection is the general lack of energy-absorbing interior side surfaces. Structural modifications alone appear to be fundamentally limited as to the extent of increased occupant protection that could be gained without associated improvement of interior sidewall energy absorption capability. Peripherally supported, laminated side glazing was found to adequately provide an energy-absorbing containment surface. However, anthropometric dummy response under the particular lateral impact conditions investigated did not conclusively demonstrate a need for such a departure from conventional monolithic tempered glass; the viability of reverting to laminated side glass was also found to be questionable. Test photographs and diagrams are provided.

by James E. Greene

Calspan Corp., 4455 Genesee St., P.O. Box 235, Buffalo, N.Y. 14221

Contract DOT-HS-4-00922

Rept. No. ZS-5562-V-2-Vol-1 ; 1976 ; 117p 9refs

Report for 30 Jun 1974-30 Oct 1975. Vol. 2 is HS-801 802;

summary is HS-801 803.

Availability: NTIS

HS-801 802

OCCUPANT SURVIVABILITY IN LATERAL COLLISIONS. VOL. 2--APPENDICES. FINAL TECHNICAL REPORT

A study was conducted to investigate the feasibility of modifications to the interior and glazing of a full-size automobile which, when combined with structural modifications to upgrade structural integrity, would enhance occupant survivability in severe lateral collision accidents. Baseline lateral collision tests, developmental testing of advanced materials, fabrication of modified vehicles, lateral collision tests for the modified vehicles, and evaluation of the results were carried out. Baseline test data, modified vehicle test data, and laminated glazing test data are fully presented. Included are crash test summaries, time-acceleration-velocity-displacement graphs, and photographs (before and after) of the tests.

by James E. Greene

Calspan Corp., 4455 Genesee St., P.O. Box 235, Buffalo, N.Y. 14221

Contract DOT-HS-4-00922

Rept. No. ZS-5562-V-2-Vol-2 ; 1976 ; 681p

Report for 30 Jun 1974-30 Oct 1975. Vol. 1 is HS-801 801;

summary is HS-801 803.

Availability: NTIS

HS-801 803

OCCUPANT SURVIVABILITY IN LATERAL COLLISIONS. SUMMARY REPORT. FINAL TECHNICAL REPORT

by James E. Greene
Calspan Corp., 4455 Genesee St., P.O. Box 235, Buffalo, N.Y. 14221
Contract DOT-HS-4-00922
Rept. No. ZS-5562-V-3 ; 1976 ; 33p 4refs
Report for 30 Jun 1974-30 Oct 1975. For abstract see HS-801 801.
Availability: NTIS

HS-801 804

MOTORCYCLE HEADLIGHTING RESEARCH. FINAL REPORT

A research program was conducted which: quantified the characteristics of currently available motorcycle headlamps; examined the headlamp aim of 90 in-service motorcycles; examined the eye fixations of two motorcycle drivers (males, aged 21 and 28) while operating a motorcycle in daylight; provided subjective ratings of a number of quantitatively different low beam headlamps which were evaluated in terms of photometric characteristics of the lamps; determined subjectively desirable headlamp aim by enabling 20 motorcyclists to aim a headlamp while driving at night at two different speeds; and provided comparisons of the relative efficiency of a number of high and low beam headlamps in field target identification tests. Results of these studies indicate that motorcycle headlamps should distribute illumination in areas on or about the road surface that are not dealt with by the low beam motorcycle photometric standard specified in Federal Motor Vehicle Safety Standard 108. New photometric standards, based on the various findings, are recommended for three classes of motorcycles representing three maximum speed categories. Recommendations are also made concerning standardization of physical specifications of motorcycle headlamps, maintenance of electrical system design voltage, and improvement of the aimability of motorcycle headlamps.

by Samuel P. Sturgis
University of Michigan, Hwy. Safety Res. Inst., Ann Arbor, Mich. 48105
Contract DOT-HS-4-00907
Rept. No. UM-HSRI-HF-75-3 ; 1976 ; 165p 10refs
Report for 1 Jul 1974-20 Aug 1975.
Availability: NTIS

HS-801 805

PROBLEMS OF INFERENCE IN STUDIES OF SEAT BELT EFFECTIVENESS. FINAL REPORT

A preliminary theoretical guide for improved studies on seat belt effectiveness is presented. Seat belt effectiveness in accidents is initially discussed from a population parameter point of view. Three measures (odds ratio, relative risk, and riddit) are introduced and their features explored. Several inferential problems are discussed, certain simplifications obtained, and some methodology is developed. Also included are some exploratory studies of the degree of misclassification errors involved in the police reports on belt usage and degree of injury, and an evaluation of the effects that such errors might have on

developed for investigating the bivariate injury distribution for belted and unbelted drivers to provide insight into the mechanism of the injury-reducing potential of belts in accidents. A method is devised for obtaining a consistent estimator of the variance of a statistic which can be used in analyzing data with ordered response categories, such as injury levels in belt effectiveness studies.

by Yosef Hochberg
University of North Carolina, Hwy. Safety Res. Center, Chapel Hill, N.C. 27514
Contract DOT-HS-4-00897
1976 ; 67p 30refs
Report for 1 Jul 1974-30 Nov 1975.
Availability: NTIS

HS-801 806

IMPROVED EXPOSURE MEASUREMENTS. FINAL REPORT

A cost-effective procedure for estimating vehicle miles of travel (VMT) categorized by driver-vehicle-environment characteristics is discussed. This procedure utilizes the following data sources: odometer readings recorded during the state vehicle inspections; the number of registered vehicles; and supplemental driving exposure information obtained through a mail survey of vehicle owners. A statewide field demonstration of the procedure was successfully conducted in North Carolina in 1974. Vehicle inspection receipt forms provide records of both the previous and current odometer readings. A random sample of about 9,000 passenger car inspection receipts was used to provide the data for estimating the average annual miles of travel for various vehicle make and model year combinations. Data from the vehicle registration files for three dates within the one year period studied were used to expand sample estimates of annual vehicle miles of travel to a statewide basis. About 1,000 of the owners of the 9,000 vehicles whose inspection receipts were used were surveyed using a mailed questionnaire for driving exposure information. The survey was used to collect the following information: out-of-state mileage; age and sex of drivers; the split in mileage among the various drivers of a given vehicle; and proportions of daytime and rural driving. Together the registration file and the inspection receipts provide an estimate of the distribution of total VMT cross-classified by vehicle characteristics such as make and model year. The owner survey information is used to adjust VMT estimates for out-of-state driving or to provide a finer breakdown of vehicle miles of travel. This procedure for estimating VMT can be used by any state having a vehicle inspection program. For this study, the costs included about 5 cents per inspection receipts and about 1.50 dollars per mailed survey. The remaining cost element is that associated with data processing and analysis. Improvements are needed in the recording of odometer readings.

by J. R. Stewart; S. B. White; C. A. Clayton; L. D. Bressler
Research Triangle Inst., P.O. Box 12194, Res. Triangle Park, N.C. 27709
Contract DOT-HS-022-2-418
Rept. No. 252U-760 ; 1976 ; 111p 3refs
Report for Jun 1972-Sep 1975. Prepared in cooperation with Univ. of North Carolina, Hwy. Safety Res. Center.
Availability: NTIS

HS-801 810

ACCIDENT-AVOIDANCE CAPABILITIES OF MOTORCYCLES--TECHNICAL REPORT. FINAL REPORT

A study was conducted to investigate motorcycle handling qualities, involving both transient and steady-state directional stability and control properties, and test procedures suitable for the evaluation of these properties were developed. Experimental techniques were used with one machine and simulation techniques were used with six motorcycles to identify the significant physical properties and performance measures with which to characterize the machine's accident avoidance capabilities. Emphasis was placed on evaluating the input-output relationships for the groups of motorcycles in a series of constant speed variable radius runs covering a range of cornering capability which encompasses normal operation. The primary test used for evaluating transient maneuvering and rider-vehicle interaction characteristics was the single lane change. In addition, nine motorcycle tires were tested in 18 configurations to obtain side force performance data developed through slip angle and inclination angle; measurements of the physical characteristics, including all pertinent dimensions and masses and moments of inertia of major assemblies, were determined for all machines; a special-purpose lightweight instrumentation system employing telemetering techniques was developed to enable the measurement of such variables as applied steering torque and rider lean angle; and simplified analytical models of motorcycle response were used to provide some insight regarding motorcycle stability and control. The results indicate that substantial differences in the values of several performance parameters exist among various motorcycle designs and that tire performance characteristics play a very important role in the determination of these parameters. It is concluded that the results of the study provide a firm foundation of information on several important aspects of motorcycle behavior and have identified special areas where additional study is required, including the performance of full-scale tests according to these procedures on several motorcycles, the investigation of performance as a function of such operational variables as speed and rider experience, and improvement of the simulation model to achieve validity over a wider range of operation.

by Roy S. Rice; James A. Davis; Dennis T. Kunkel
Calspan Corp., 4455 Genesee St., Buffalo, N.Y. 14221
Contract DOT-HS-4-00976
Rept. No. ZN-5571-V-1 ; 1976 ; 119p 5refs
Report for 1 Jul 1974-30 Jun 1975.
Availability: NTIS

HS-801 811

DEVELOPMENT AND EVALUATION OF MASTERBODY FORMS FOR THREE-YEAR OLD AND SIX-YEAR OLD CHILD DUMMIES. FINAL REPORT

A study was conducted to define, construct, measure, and evaluate the size, shape, and mass distribution of masterbody forms representative of 3 year old and 6 year old United States children. A list of 98 anthropometric dimensions was used to construct clay masterbody phantoms which were constructed using dimensional data abstracted from the available literature. The clay phantoms were sculptured and then reproduced exactly in dental stone. The dental stone casts were then divided into three parts representing the

head, neck, upper torso, lower torso, upper arm, lower arm, hand, upper leg, lower leg, and foot. Mass, volume, center of mass, and mass moments of inertia of the resulting segments were then experimentally determined. The ability of a mathematical model to predict mass and mass moments of inertia from anthropometric data was investigated. The segments modelled were homogenous, rigid bodies and the measured data to be compared were corrected for a mass with density equal to unity. It is concluded that more information is needed on the anthropometric descriptions of link lengths and the torso/neck linkage system with its associated mass distribution in order to develop accurate mathematical models for the purpose of predicting mass and mass moments of inertia. The anthropometric data base, including information on size, shape, linkage, and mass distribution, was found to be deficient for the immediate purpose of developing anthropomorphic test devices.

by H. M. Reynolds; J. W. Young; J. T. McConville; R. G. Snyder
University of Michigan, Hwy. Safety Res. Inst., Ann Arbor, Mich.; Civil Aeromedical Res. Inst., Oklahoma City, Okla.; Webb Associates, Inc., P.O. Box 308, Yellow Springs, Ohio 45387
Contract NHTSA-5-1494
1976 ; 111p 31refs
Report for Oct 1974-Jul 1975.
Availability: NTIS

HS-801 812

CHARACTERISTICS OF TRUCK IN SINGLE AND TWO-VEHICLE FATAL CRASHES. FINAL REPORT

The influence of truck size or weight on occupant injury severity in one and two vehicle fatal crashes was investigated. Data for the period January 1973 through June 1974 was taken from the National Highway Traffic Safety Administration's Fatal Accident Files. Of the 66,000 fatal accidents in the files for this period, about 25% involved trucks. Trucks accounted for 19% of the single vehicle fatal accidents and 39% of the two vehicle fatal crashes. Accurate information on truck weight and specific body type was found to be generally unavailable. Of the more than 9,000 single truck fatal accidents, about 90% involved trucks weighing 10,000 pounds or less. The injury rate was found to decrease with increasing weight. Analysis of car-truck fatal collisions demonstrated a generally higher fatality risk to passenger car occupants. Of the more than 7,800 driver and occupant fatalities in car-truck crashes, about 82% were passenger car occupants. The heavier the truck, the more likely the passenger car occupants will be injured fatally. Head-on impacts accounted for 41% of the car-truck fatal accidents. Varying vehicle use patterns in the light, medium (10,000 to 25,000 pounds), and heavy weight classes result in differences in the types and severity of accidents in which trucks are involved.

by H. Wuerdemann; W. W. Belew; R. M. Helfand; W. A. Holter; J. W. Overbey; W. F. Horton
Mitre Corp., 1820 Dolley Madison Blvd., McLean, Va. 22101
Contract DOT-HS-357-3-721-LA-MOD-3
Rept. No. MTR-7113 ; 1976 ; 11p 2refs
Availability: NTIS

HS-801 813

DRIVERS IN FATAL CRASHES WITH AND WITHOUT DRIVER TRAINING

A study was conducted to compare the fatal crash involvements of drivers with driver training to the fatal involvements of those drivers without such training. The data used in the analysis were taken from the Fatal Accident Files maintained by the National Highway Traffic Safety Administration for the period January 1973 through June 1974 and for those States which had reasonably reliable information on the status of driver training. About 71% of the drivers involved in fatal accidents were found to have had no prior driving training. Of the drivers with training, 90% were 30 years of age or younger. A comparison of the fatal involvements using the driver's prior conviction or license suspension records showed no differences between those with and without driver training. Drivers without driver training had a higher percentage of positive blood alcohol concentration test results (67%) than did drivers with training (57%).

by H. Wuerdemann; W. W. Belew; J. W. Overbey; W. F. Horton
Mitre Corp., 1820 Dolley Madison Blvd., McLean, Va. 22101
Contract DOT-HS-357-3-721-IA-MOD-3
Rept. No. MTR-7112 ; 1976 ; 10p 3refs
Availability: NTIS

HS-801 814

DETERMINING TARGET DRIVERS FOR SPEED-ORIENTED COUNTERMEASURES

In an effort to reduce the number and severity of motor vehicle accidents, the National Highway Traffic Safety Administration (NHTSA) is considering the possibility of directing speed-oriented countermeasures toward selected drivers. One countermeasure under consideration is the installation of speed governors to limit vehicle speed to a prespecified limit. A fundamental element in initiating a program of this sort is the identification of the drivers to become targets of the particular countermeasure. Speed limit compliance among drivers involved in fatal accidents was examined and national estimates of the number of drivers whose involvement in a fatal accident would have been affected by a 55 mph speed curb were developed. Information from a NHTSA data file on fatal traffic accidents was used for these analyses. Drivers were divided into 46 groups based on the following variables: driver sex; driver age; driver marital status; and prior driving record, as determined by previous accidents, license suspensions, and moving violations. Based on this stratification of the driver population in fatal accidents, speed limit compliance was determined for each of the 46 driver groups. The highest tendency to speed (67.7%) was exhibited by married males ages 16 to 20 with poor prior driving records, while females older than 69 were found to have sped least often (5.7%) prior to the fatal involvement. Male drivers under 40 years of age were, by and large, more likely to have been speeding prior to fatal involvement than other drivers. It was estimated that about 25% of all drivers involved in fatal accidents nationally were both speeding and exceeding the 55 mph.

by W. F. Horton; W. W. Belew; H. Wuerdemann; J. W. Overbey
Mitre Corp., 1820 Dolley Madison Blvd., McLean, Va. 22101

HS-801 815

RESEARCH SAFETY VEHICLES (RSV). PHASE 2. THIRD STATUS REPORT

The development of a Research Safety Vehicle (RSV) by Calspan Corporation is discussed. Key technical decisions with regard to the RSV front structure force-deflection characteristics and the front seat occupant restraint systems were made during this reporting period. Bumper pedestrian impact simulations were conducted using both adult and child models. Extensive front-to-side vehicle-to-vehicle impact simulations were performed to aid in the design of the front structural force-deflection characteristics. Efforts were begun to consider occupant responses in the vehicle-to-vehicle impact model. Effort was initiated on the development of an energy absorbing door inner panel. Air bag computer simulations were performed and a preliminary passenger side design was developed. Air bag analytical results were compared with those developed from sled tests. Although the simulations tend to correctly predict limiting acceleration values, they also tend to predict somewhat earlier occupant loadings than were evident in the tests. Belt systems simulations were continued and a preliminary design developed. Belt system computer simulations were compared to test data and in general the simulation results are viewed as a reasonable indication of expected performance. However, the simulations tend to predict larger knee bar penetration than that which was observed in the tests. The candidate bumper foam material was subjected to an extensive series of body block, flat barrier, and vehicle impact tests.

Calspan Corp., Buffalo, N.Y. 14221
Contract DOT-HS-5-01214
Rept. No. ZM-5793-V ; 1976 ; 133p
Report for 16 Nov 1975-15 Jan 1976.
Availability: Reference copy only

HS-801 819

DEVELOPMENT OF AN AIR BAG-CRUSHABLE DASH-KNEE BAR PASSIVE RESTRAINT SYSTEM FOR SMALL CARS. SUMMARY REPORT

by David J. Romeo
Calspan Corp., 4455 Genesee St., Buffalo, N.Y. 14221
Contract DOT-HS-4-00972
Rept. No. ZM-5566-V-2 ; 1976 ; 36p
Report for Jun 1974-Dec 1975. For abstract, see HS-801 789.
Availability: NTIS

HS-801 820

ADMINISTRATIVE ADJUDICATION OF TRAFFIC INFRACTIONS. HIGHWAY SAFETY ACT OF 1973 (SECTION 222) [ANNUAL REPORT NO. 1]

The results of research and demonstration projects concerning administrative adjudication of traffic infractions conducted by or for the U.S. Department of Transportation are presented and discussed. The American Bar Association's Center for Administrative Justice conducted a survey of a number of traffic infraction processes in the country. This survey showed that administrative adjudication and noncriminal case processing offers considerable potential for improving the way traffic

involved in traffic case disposition systems approaches which involve noncriminal traffic infraction processing and self-adjudication by mail-bail forfeiture of all violators except habitual offenders indicated that the lack of adequate system resources is a major obstacle to improvement. A special study of the New York Administrative Adjudication Program (NYAAP) identified the computer-based record information system as the key to the program's success. NYAAP also uses an administrative approach to traffic case disposition, involving the use of informal, uncontested guilty-with-explanation hearings to process the bulk of the appearance caseload, which has been found to offer considerable benefits in all areas, especially efficiency. An analysis of the use of criminal sanctions and processes in 11 major metropolitan areas demonstrated limited use of counsel, juries, and jail in traffic infraction cases. Traffic adjudication processes have been classified as judicial, modified judicial, and administrative and have been evaluated on the basis of fairness, efficiency, and effectiveness. While no approach has been found to be more beneficial to highway safety than any other, the administrative approach is more structurally oriented toward problem driver identification, review, and sanctioning. The National Traffic Highway Safety Administration has funded Special Adjudication for Enforcement demonstration projects which will provide detailed evaluation of administrative adjudication and noncriminal traffic infraction processing fairness, case disposition efficiency, and effectiveness.

National Hwy. Traffic Safety Administration, Washington, D.C. 20590
Rept. No. AR-1; 1975; 90p 96refs
Availability: Corporate author

HS-801 821

EMERGENCY MEDICAL SERVICES PROGRAM ADMINISTRATION PROTOTYPE CURRICULUM. CURRICULUM GUIDE

A guide is presented: to describe the prototype curriculum developed for emergency medical service (EMS) program administration, including the organization, overall structure, and scope of the curriculum and its content, objectives, and suggested methods of instruction; to define the rationale for the design of the prototype curriculum, including identified needs for this kind of program, the program design goals, and the assumptions underlying the design characteristics; and to direct those interested in more detailed curriculum content to appropriate sections of the resources materials document included in the curriculum package. The prototype curriculum is designed to be comprehensive and to include all knowledge and skills needed to perform the functions and tasks involved in EMS administration and management. The program is designed particularly for new entrants into the field of EMS administration, although much of the curriculum should also be helpful to incumbents. Instruction is planned at the college level and is designed in a manner appropriate to the backgrounds, attitudes, and learning skills of mature adults. The program is designed to develop the skills necessary to plan, implement, coordinate and maintain, and evaluate EMS programs. The prototype curriculum is divided into the following six modules: government and health care (American government, health care resources and structure, and health care issues and government); human relations and communica-

tions; management theory and principles; background information, fundamentals of administration, and quantitative methods for administrators; EMS delivery dimensions and status (evolution of EMS concern, EMS elements and requirements, current EMS operations, and EMS issues); EMS delivery systems (systems background, information and data communications, and EMS system development); and EMS program administration (the EMS program context, EMS program administration, accounting and budgeting, and contracts and grants). The scope and objectives of each module are described and references for use in each component are outlined.

National Hwy. Traffic Safety Administration, Washington, D.C. 20590
1975; 161p
Availability: GPO

HS-801 822

RESEARCH SAFETY VEHICLE. PHASE 2. (RSV) PROGRESS REPORT NO. 3, NOVEMBER 17, 1975 TO JANUARY 16, 1976

Progress in the development of a research safety vehicle (RSV) by Minicars, Inc. is reported. General vehicle design is considered: interior/exterior buck; door/sill design; front end design; seat design; mechanical systems (braking system and ride/handling system); and cost and weight estimates. Structural design and development are discussed: analysis (dynamic response modeling, door stress analysis, cowl analysis); road load analysis; fabrication of vehicle structures; scale model testing (RSV front to RSV side, component scale model testing, and future tests); development of foamed structures (strain rate effect and foam formulation); and dynamic test results (frontal offset barrier impacts at 43 and 45 mph, frontal barrier tests at 9 and 17 mph, and a 30 mph Pinto front to RSV side impact using a 50th percentile male dummy). Restraint system development is also reported: driver restraint; right front passenger restraint system; rear seat restraint system; and side impact protection. Subcontractor progress reports, proposal options, vehicle structural drawings, RSV sled and static out-of-position child test data, and an interim report on handling criteria and design goals for the RSV ride/handling subsystem are appended.

Minicars, Inc., 35 La Patena Lane, Goleta, Calif. 93017
Contract DOT-HS-5-01215
Rept. No. MIN-PR-226; 1976; 370p
Availability: Reference copy only

HS-801 824

HANDLING TEST PROCEDURES FOR LIGHT TRUCKS, VANS, AND RECREATIONAL VEHICLES. FINAL REPORT

The results of a multidiscipline investigation of the safety-related handling behavior of recreational vehicles are presented. A pragmatic set of dynamic performance test procedures suitable for making first order appraisals and evaluations of the handling performance of light trucks, vans, and truck chassis-based recreational vehicles under realistic highway driving maneuvers were developed. Specific vehicles considered included a Class A motor home, Class C motor home, Volk-

swagen van, pickup and camper, and a four-wheel drive Jeep Wagoneer. Each vehicle was simulated on an updated hybrid computer to aid in the development of test procedures. Vehicle physical properties were measured during the program for use in the computer simulations. The procedures were then validated and refined by testing. A set of six procedures was developed: braking-in-a-turn, sinusoidal steer, trapezoidal steer, trapezoidal steer while braking, road roughness in a turn, and crosswind sensitivity.

by R. L. Anderson; L. E. Wesson; D. S. Starr; F. Jindra
Ultrasystems, Inc., Dynamic Science Div., 1850 West Pinnacle
Peak Rd., Phoenix, Ariz. 85027
Contract DOT-HS-4-00853
Rept. No. 8256-75-168; 1976; 309p 14refs
Report for Mar 1974-Nov 1975. For summary rept., see HS-
801 825.
Availability: NTIS

HS-801 825

HANDLING TEST PROCEDURES FOR LIGHT TRUCKS, VANS, AND RECREATIONAL VEHICLES--SUMMARY REPORT. FINAL REPORT

by R. L. Anderson; L. E. Wesson; D. S. Starr; F. Jindra
Ultrasystems, Inc., Dynamic Science Div., 1850 West Pinnacle
Peak Rd., Phoenix, Ariz. 85027
Contract DOT-HS-4-00853
Rept. No. 8256-75-177; 1976; 31p
Report for Mar 1974-Nov 1975. For abstract see HS-801 824.
Availability: NTIS

HS-801 826

A COMPARISON OF ALCOHOL INVOLVEMENT IN EXPOSED AND INJURED DRIVERS. PHASES 1 AND 2. FINAL REPORT

Alcohol-related data collected from drivers involved in injury-producing automobile accidents are compared with the same type of data collected from drivers who were similarly exposed to these mishaps but who did not have accidents. Collection of data involved: interviewing and measuring blood/breath alcohol content (BAC) of 596 accident drivers in Huntsville, Alabama, at the scenes of accidents, in hospitals, or at police stations; and interviewing and measuring BAC's of 804 non-accident drivers at the same location of each accident and at the same time of day, day of week, and direction of travel. Questionnaires and interview forms for both types of drivers are appended. The most relevant findings were: drivers involved in injury-producing accidents had significantly higher BAC's than drivers exposed to the same environment but not involved in accidents; drivers who had a high BAC level were more likely to become involved in an injury-producing accident than drivers who did not have a high BAC; and drivers who were driving with a BAC greater than or equal to .030 were found to be at fault more frequently in injury-producing accidents than drivers who were also involved in accidents but had not been drinking.

by R. Farris; T. B. Malone; H. Lilliefors
Essex Corp., 201 North Fairfax St., Alexandria, Va. 22314
Contract DOT-HS-4-00954

HS-801 827

EVALUATION OF SELF-CONTAINED ANTHROPOMORPHIC DUMMY DATA ACQUISITION SYSTEM. FINAL REPORT

A self-contained solid state digital data acquisition system mounted in a 50th percentile male anthropomorphic dummy is evaluated. The program consisted of conducting five automobile crash tests of various types with the crash-recorder equipped dummy occupying different seating positions in each test and restrained by either conventional belts or an air cushion restraint system: a 30 mph barrier crash, one dummy on passenger side with lap and torso belt in 1975 Oldsmobile; 30 mph barrier crash, one dummy, passenger side, air cushion restraint, 1975 Buick; 30 mph barrier crash, one dummy in driver position, lap belt only, 1975 Buick; 20 mph impact on driver side with moving barrier, one dummy, driver side, 1975 Volkswagen Rabbit; and 20 mph impact on passenger side with moving barrier, one dummy, driver side, 1975 Rabbit. Following each test the data was extracted from the self-contained recorder and transcribed onto magnetic tape along with the appropriate calibration signals. Each vehicle was instrumented with a triaxial accelerometer mounted on the rear drive tunnel housing. These signals and signals from three chest displacement transducers mounted in the dummy were conditioned on-board the vehicle and transmitted through a trailing umbilical cable to be recorded in a conventional manner at a fixed ground station. Data plots for each of the five tests are appended.

by E. Enserink
Ultrasystems, Inc., Dynamic Science Div., 1850 West Pinnacle
Peak Rd., Phoenix, Ariz. 85027
Contract DOT-HS-6-01295
Rept. No. 3961-75-178; 1976; 143p
Report for 1 Oct-31 Dec 1975.
Availability: NTIS

HS-801 828

MARIHUANA CONTACT TEST, EVALUATION AND DEVELOPMENT. FINAL REPORT

Methods for detecting human contact with marihuana were investigated in a program designed to both evaluate a previously used method and develop a new method for future use. A colorimetric swab test was evaluated using 100 blank swabs, 500 swabs spiked with Tetrahydrocannabinol, and 560 swabs spiked with possible interferences. Also, swab tests were conducted on 100 subjects' hands exposed to marihuana smoke on the lips, fingers, and palates of 50 corpses, and the lips, fingers, and palates of 90 male marihuana smokers after they smoked one marihuana cigarette each. The test was found to be capable of detecting only 83% of marihuana smokers immediately after smoking and was also demonstrated to be subject to a wide range of possible interferences. An alternative test was developed using thin-layer chromatography as the method for detecting marihuana constituents from a skin swab. Subjects were drawn from a pool of over 200 adult males. The test detected 86% of the smokers immediately after smoking and was not demonstrated to be subject to any interference. A copy of a letter and questionnaire sent to individuals and

agencies across the country to identify uses to which the tests will be put and a list of the recipients are appended.

by Edward J. Woodhouse
Midwest Res. Inst., 425 Volker Blvd., Kansas City, Mo. 64110
Contract DOT-HS-4-01003
Rept. No. 3964-C ; 1976 ; 130p 4refs
Report for 27 Jun 1974-31 Oct 1975.
Availability: NTIS

HS-801 830

DATA ANALYSIS FOR DRIVER PERFORMANCE STUDIES. VOL. 1. PDP-8 DATA ACQUISITION SYSTEM FOR DRIVER SIMULATION LABORATORIES. FINAL REPORT

A data collection and handling system developed for driving simulation laboratories is described. The system is based on a PDP-8 computer with data analysis conversion capabilities and a magnetic tape drive. The systems output is an IBM 360 compatible 9-track magnetic tape. Software developed for sampling and recording driver response data is documented completely so that a programmer familiar with the PDP-8 could use and modify the program. A user's manual is included providing enough information for a nonprogrammer to use the facility in an experiment. The problems with the system include: the 4K limitation on PDP-8 core combined with the need for long records prohibits the use of an input buffer; the 370 tape drives used at the IBM installation have more stringent threshold and timing requirements than do the older 360 tape drives; and the PDP-8 memory size does not allow FORTRAN programming.

by Raymond W. Burger, Jr.; Richard Kemmerer; Herbert A.

Moskowitz
Amex Systems, Inc., 5319 W. 146th St., Lawndale, Calif. 90260
Contract DOT-HS-4-00807; Ref: DOT-HS-150-3-668
Rept. No. Amex-0105-Vol-1 ; 1976 ; 264p 3refs
Report for Nov 1973-Dec 1974. Vol. 2 is HS-801 831.
Availability: NTIS

HS-801 831

DATA ANALYSIS FOR DRIVER PERFORMANCE STUDIES. VOL. 2. A COMPUTER PROGRAM FOR ANALYSIS OF EYE MOVEMENT PATTERNS. FINAL REPORT

A digital computer program is described which analyzes visual search data from subjects watching a traffic film while performing a simulated driving task. Classification of eye states into saccades, fixations, pursuits, and blinks, statistical summaries of eye movement patterns, analysis of "looks" at pre-selected events in the film, and analysis of a discrete response task performed by the subject are included in the capabilities of the program. Sources of error and program accuracy are discussed. Flow charts, definitions of variables, a computer program (FORTRAN) listing, and a sample output sheet are provided. Computer costs for running this program as presently configured are about \$15 per 20 minute experimental run.

by Robert A. Niemann; Ken Ziedman
Amex Systems, Inc., 5319 W. 146th St., Lawndale, Calif. 90260
Contract DOT-HS-4-00807; Ref: DOT-HS-150-3-668
Rept. No. Amex-0105-Vol-2 ; 1976 ; 63p 2refs
Report for Nov 1973-Dec 1974. Vol. 1 is HS-801 830.
Availability: NTIS

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